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COGNITIVE TRAINING WITH RETARDED CHILDREN, I. FINAL REPORT.
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THE MAJOR PURPOSE OF THIS RESEARCH WAS TO DETERMINE WHETHER TRAINING IN SPECIFIC COGNITIVE PROCESSES IS EFFECTIVE IN INCREASING THE COGNITIVE FUNCTIONING OF RETARDED CHILDREN. IN PHASE I OF THE PROJECT, 51 EDUCABLE RETARDED AND 18 NORMAL SUBJECTS RECEIVED A 20-DAY PROGRAM IN SIMILARITIES-DIFFERENCES CONCEPT FORMATION AND WERE COMPARED WITH 42 EDUCABLE RETARDED AND 24 NORMAL CONTROL SUBJECTS. CHANGE SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS ON 30 TEST VARIABLES, INCLUDING CONCEPT FORMATION, REASONING, INTELLIGENCE, AND ACHIEVEMENT TESTS, WERE COMPARED BY T TESTS AND A MULTIVARIATE ANALYSIS OF VARIANCE. THE HYPOTHESIS CONCERNING IMPROVEMENT IN CONCEPT FORMATION WAS STRONGLY SUSTAINED. ALSO GAINS WERE OBSERVED IN RELATED AREAS OF REASONING AND, TO A LESSER EXTENT, IN VERBAL AREAS. HYPOTHESES OF CHANGE IN GENERAL INTELLIGENCE AND ACHIEVEMENT WERE NOT SUSTAINED WHEN SIMILARITIES-DIFFERENCES EFFECTS WERE REMOVED, ALTHOUGH A GENERAL TREND IN FAVOR OF THE EXPERIMENTAL GROUPS WAS NOTED. IN PHASE II, 16 EDUCABLE RETARDED AND 16 BRIGHT NORMAL SUBJECTS RECEIVED A 20-DAY PROGRAM IN COGNITIVE FLEXIBILITY AND WERE COMPARED TO 16 CONTROL SUBJECTS IN EACH GROUP BY A 2 X 2 FACTORAL DESIGN. CHANGE WAS MEASURED BY A FLEXIBILITY TEST BATTERY, COMPOSED OF FIVE SUBTESTS, AND THE STANFORD-BINET INTELLIGENCE SCALE. SIGNIFICANT IMPROVEMENT IN THE PREDICTED DIRECTION WAS FOUND FOR BOTH TEST VARIABLES. IN PHASE III, A TEST AND TRAINING PROGRAM IN THE AREA OF PRODUCTIVITY-RESPONSIVENESS WAS DEVELOPED TO THE TRYOUT STAGE. APPENDIXES INCLUDE DAY BY DAY PLANS FOR (1) THE SIMILARITIES-DIFFERENCES CONCEPT FORMATION TRAINING PROGRAM, (2) THE COGNITIVE FLEXIBILITY TRAINING PROGRAM, AND (3) TEACHERS' MANUAL OF THE PRODUCTIVITY-RESPONSIVE TRAINING PROGRAM. THE FACTOR ANALYSIS OF THE FLEXIBILITY TESTS AND THE COGNITIVE TRAINING EXPERIMENTAL TEST BATTERY ARE INCLUDED. BIBLIOGRAPHY CITES 44 ITEMS. (AUTHOR)

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COGNITIVE TRAINING WITH RETARDED CHILDREN. I

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Cognitive Training with Retarded Children, I

Grant No. 32-43-0530-5028

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PROBLEM

The general problem to which this research addressed itself was one of whether or not retarded children could be improved in their thinking processes in a specific area to an extent that this would generalize to other cognitive areas and academic areas.

More specifically, the question of whether training in similarities-differences concept formation, and hereinafter referred to as Phase I, could be given that would have effects in this area; related areas of thinking, intelligence, psycholinguistic ability; and in achievement. The development of a test and training program in flexibility-rigidity or concept flexibility areas, hereinafter referred to as Phase II, and preliminary evaluation of it also were undertaken. A program in (fluency) productiveness-responsiveness, hereinafter referred to as Phase III, was developed to the tryout stage.

It has frequently been observed but not often demonstrated that retarded children have difficulty in conceptualizing, and the experience of the author in evaluating many retarded children has consistently pointed this out as a major area of weakness in their thinking processes. The question arose whether or not this process or processes could be improved through a training program oriented toward giving emphasis to the process involved rather than supplying contents to be manipulated, except inadvertently. Similar status-of-difficulty on retardates has been observed and similar questions were considered in the area of flexibility-rigidity or conceptual flexibility in a developmental program aimed at more thorough tryout in 1967. Similarly, an area tentatively identified as productivity-responsiveness in retarded children has been observed to be a deficiency. In this area, a program aimed at initial tryout has been developed.

The general strategy of improving children's abilities in specific cognitive areas is based upon a theoretical frame that distinguishes among different modes of information acquisition, manipulation, and manufacture in a developmental hierarchical scheme. Many types of information are genetically stored in the organism. These types are, of course, not amenable to alteration in any basic sense, at least through educational processes. For want of a better term, behaviors of this class are referred to as instinctoid.

Behaviors of a higher class, developmentally, are called learning, in which information is acquired, not as with instinctoid behaviors over the course of a number of generations, but within the lifetime of the organism or some portion thereof. This class of behaviors is in turn superseded by a variety of information acquisition, which generally occurs more rapidly than learning, and has broader application. A final stage in the hierarchy is called creativity in which information is anticipated and manufactured by employing the future in a figurative sense.

Applying this scheme to retarded children of school age, the suggestion emerges that retardates are focused on learning modes, and too slowly and too late acquire thinking or reasoning modes necessary for cognitive development that modern life requires with its rapid change and flux. This research was generally oriented to the emendation of this deficiency.

Objectives

The over-all long-range objectives of this research program, of which this portion was a beginning, were: (1) to define a cognitive hierarchy in retarded children, (2) to explore the developmental sequencing of such a hierarchy, (3) to develop tests to measure each area, (4) to develop a training program in each area that will improve performance, and by such improvement (5) to enhance the behavioral efficiency of the retardate in the cognitive area. Another way of stating the broad goals of this program is in developing a "cognitive curriculum," emphasizing process rather than content, (1) to develop effective measures for evaluation in these various areas, (2) to accelerate the retardate up the cognitive hierarchy by making him more a reasoner and less a learner, and (3) to alter his cognitive style and behavior.

All three of the programs devised were aimed at correcting or improving or ameliorating specific deficiencies commonly observed in retarded children.

Specifically the major emphasis in Phase I in this research was to test the efficacy of a training program in similarities-differences concept formation in school settings and under school conditions. A secondary emphasis in Phase II was to develop a test and training program in the area of cognitive flexibility and to conduct a preliminary tryout of this program and its effectiveness. A third minor objective in Phase III was to develop a test and training program to the tryout stage in the area of productivity--responsiveness (fluency).

Related Research

Cognitive Training in a variety of forms has become increasingly popular within the last few years. Prior to that time, attempts at training cognitive functions took typically learning forms. Typical here were Montesorri methods of sensory and motor training and a number of efforts at conceptual training in the area of arithmetic (Montesorri, 1912). Thurstone (1949) designed a series of training exercises in workbook format in the primary mental abilities and reported success in improving reasoning in this manner. Skinner (1961a,b) described a program on teaching machines for making discrimination and learning concepts. A number of other investigators reported efforts at cognitive training with variable results (House and Zeaman, 1958a, 1960; Zeaman *et al*., 1958; Chansky and Taylor, 1964; Miller and Griffith, 1961). In many other instances short programs, usually used as an independent variable, have been employed in testing experimental hypotheses in this area.

More recently McDonald (1965) reported on the effects of a program in similarities-differences concept training that served as a pilot study for the present analysis. She found highly significant improvement in this area, and a tendency to improve intelligence. A study using McDonald's materials was undertaken with a Head Start group by Blizzard (1966) with similar results, except that readiness was employed as a criterion rather than intelligence. This function improved significantly in one group that was more deprived as well as showing improvement in the two groups employed in concept formation.

In the flexibility area, studies such as those of Harlow (1963), Ellis *et al*. (1962), Dickerson (1963), Callantine and Warren (1955), Semme and Warren (1955), Ackerman and Lewin (1958), using a variety of subjects and tasks, obtained an equal variety of results and effects with various experimental manipulations. In general, the idea that a "flexibility set" can be attained under some conditions, and that this facilitates performance on other cognitive tasks appears to be demonstrated.

A recently reported study (Rouse, 1965) tested the effects of a training program in productive thinking using "brainstorming" materials with a group of educable retarded children. This study obtained significance differences between experimental and control groups on tests scored for fluency, flexibility, originality, and elaboration. These results are suggestive for the program in productiveness-responsiveness.

In summary, a number of related experiments in the three areas of concern to this research have indicated good possibilities for leverage in improving general cognitive functioning as well as the specific processes under investigation.

PHASE I

Procedure

This research was divided in three phases. It would seem advantageous to break down the remainder of the report according to these phases, since they are distinct in all aspects. Phase I refers to training in similarities-differences concept formation. Phase II refers to training in flexibility-rigidity or concept flexibility areas. Phase III refers to productiveness-responsiveness training.

Phase I was concerned with the Similarities-Differ-Concept Formation Test.

Two major hypotheses were tested in this phase:

1. A group of subjects given similarities-differences concept formation training would show significantly greater improvement in this area over a group not given such training.

2. Trained subjects would show improvement in general cognitive functioning as measured intelligence over untrained subjects.

Subjects

The subjects in this experiment were 93 educable retarded children in eight classes for educable retarded and 42 first-grade children for a total sample of 135. Among retardates, two classes--one experimental and one control--were from a large city; two classes--one normal and one control--were from a rural county; and four classes--two experimental and two control--were from a small city-county system while one experimental and one control class of first graders with low average IQ's from a lower class area of the last location served as a normal control group. Of the 93 retarded subjects, 51 were in experimental groups and 42 in the control group. The normal experimental group was made up of 18 Ss and the normal control group of 24 Ss. An original group of 168 children was tested. More than anticipated losses were encountered in the control group, due largely to two factors. In one case, students were reshuffled without the experimenter's knowledge between control and experimental groups, and in another case, a family of children (3) was lost. Other than this, attrition was regarded as normal with strong effort to retain all subjects.

An investigation of various variables as chronological age, mental age, IQ, and race showed no significant differences between experimental and control groups in both retarded and normals. It was therefore assumed that the groups were adequately matched. It should be noted that the age range was slightly greater than the 6-12 range originally planned, since in the experimental and control groups a few 13-year-olds and one 14-year-old were used.

The Test Battery

The test battery consisted of the Corter-McDonald Similarities Differences Concept Formation Test (a complete description of this test is given in Appendix I as reported by McDonald, (1965); the Stanford-Binet Intelligence Scale, Form L-M (1965) (alternate items were given at all age levels where similarities and/or differences items occurred); the Wechsler Intelligence Scale for Children (Digit Span was routinely given as well as Similarities, so that it could be substituted for it); and the Auditory-Vocal Association and the Visual Motor Association subtests of the Illinois Test of Psycholinquistic Abilities. The California Achievement Test was also given, but it was quickly apparent that not all parts of this test were appropriate for the retarded group. The specific tests given to all retarded groups were Word Form, Word Recognition, Meaning of Opposites, Picture Association, Arithmetic Meanings, Addition, and Word Usage. On the first testing, several of the younger groups only scored at a chance level on the other tests of this battery and these were omitted on the second testing. Partial data on several of these tests were obtained where children's abilities were appropriate.

Pre-testing was conducted in the various locations from late September to middle December, and post-testing from middle February to late April in approximately the same sequence and time interval. Effort was made to counterbalance examiners. In only a few cases were the same children retested by the same examiners.

The normal experimental and control groups were tested only with the Similarities-Differences Test and the Stanford-Binet, since this was felt to be sufficient for determination of regression effects.

The Training Program

The training program was developed by McDonald (1965). It consisted of twenty days' work of one-half hour each designed to be taught during a school month. It should be noted that this time varied somewhat with different groups and on different days, but in general averaged out to ten hours of training for all groups. Gradual development of concepts was assigned to begin with presentation of concrete objects, followed by pictures and finally by corresponding verbal concepts. The developmental sequence of gross differences, to gross similarities, to more specific differences, and more specific similarities also was followed.

Concepts taught included concepts of "both," "each," "same," "alike," "different," and "similar." These concepts were illustrated throughout the training session.

The training program is described in detail in Appendix A. The instruction was given to groups of Ss as a class, but individual help was available when Ss completed items for their workbooks and during class discussion. Ss also worked individually with a teaching machine. Materials used included crayons, colored chalk, regular chalk and blackboard, modeling clay, and numerous small objects.

Experimental Procedures

As noted above, the basic data collected in this research were difference scores between post- test and pretest scores on the various measures used. These scores were obtained four to six months apart in approximately the same sequence as originally collected. A slight exception was with normal E and C groups, where tests were three to four months apart. Pre-testing covered the period from September 15 to December 15, and post-testing from February 1 to May 1. The training program covered the period from January 3 to February 15.

Statistical Methods

T-tests were computed on differences between means of difference scores on the variables listed below in Table I.

Table I. Variables used in statistical analysis

	Test	M_E	M_C	t	Probability Level
1.	Number of similarities and differences on the Stanford-Binet[1]	.87	.50	1.796	.05
2.	Mental Age on SB* (months) (without similarities items)	5.32	4.47	.695	ns
3.	SB IQ without similarities-differences items	2.50	1.42	.970	ns
4.	Corter-McDonald Similarities-Differences Test	27.34	6.73	5.630	>.005
5.	S. B. IQ including similarities-differences items	3.70	2.23	1.286	.10
	WISC				
6.	Information (scaled scores)	.49	.21	.854	ns
7.	Comprehension	.81	.57	.444	ns
8.	Arithmetic	.16	.94	-1.898	.05
9.	Similarities	2.58	.52	3.021	>.005
10.	Vocabulary	.74	-.13	2.159	.05
11.	Digit Span	.43	-.02	1.172	ns
12.	Picture Completion	.74	.78	- .076	ns

[1] These occur in the ranges employed in this test at year IV-6, 3; V, 5; VI, 2; VII, 2; VIII, 4; and very rarely at XI, 6. No subjects reached year XIV level.

NOTE: See limitations discussion.

Table I (continued)

Test	M_E	M_C	t	Probability Level
13. Picture Arrangement	.36	.92	-1.212	ns
14. Block Design	.69	.76	- .142	ns
15. Object Assembly	1.43	1.05	.709	ns
16. Coding	.65	1.21	-1.253	ns
ITPA Variables				
17. Auditory-Vocal Association	1.70	.31	2.344	.05
18. Visual-Motor Association	2.23	.81	1.504	.10
California Achievement Variables[2]				
19. Word Form	3.94	3.34	.541	ns
20. Word Recognition	1.25	2.86	-2.584	.01
21. Meaning of Opposites	.65	1.84	-1.898	.05
22. Picture Association	1.80	.68	2.290	.05
23. Arithmetic Meanings	3.90	1.97	2.371	.05
24. Addition	1.34	.76	.901	ns
25. Word Usage	3.29	1.94	1.148	ns

[2] See test discussion for these variables.

Table I (continued)

Test	M_E	M_C	t	Probability Level
26. WISC Verbal IQ without Similarities and with Digit Span	3.27	1.97	.963	ns
27. WISC Verbal IQ with Similarities and without Digit Span	6.14	2.76	2.061	.05
28. Performance IQ WISC	5.64	6.90	- .910	ns
29. WISC Total IQ without Similarities and with Digit Span	4.88	4.72	.146	ns
30. WISC Total IQ with Similarities and without Digit Span	6.57	4.87	1.328	.10

The multivariate analysis of variance results are shown in Table III. It should be pointed out that these results are only regarded as tentative or suggestive, since a number of factors not anticipated somewhat limited their interpretation. For example, the number of variables employed in the 25x25 approached the limits of the computer employed in storage space and general capacity, the relatively small differences found in some instances caused difficulties in the iterative procedures employed, and the final results can only be regarded as significant to one decimal place. Like Beta weights in regression equations, or the factor results from machine programs, results can only be interpreted in respect to the

Table III. Weights of Variables on Multivariate Analysis

	Variables	Weight
1.	No. of S.D. (S.B. L-M)	0.04
2.	MA	-0.2
3.	IQ - without	0.3
4.	Sim-Diff	0.06
5.	IQ - with	-0.01
	WISC:	
6.	Information	0.19
7.	Comprehension	-0.07
8.	Arithmetic	-0.1
9.	Similarities	0.16
10.	Vocabulary	-0.02
11.	Digit Span	0.09
12.	Picture Completion	0.03
13.	Picture Arrangement	-0.3
14.	Block Design	-0.1
15.	Object Assembly	-0.0
16.	Coding	-0.47
	ITPA:	
17.	Auditory-Vocal Association	0.2
18.	Visual-Motor Association	0.03
	California Achievement Tests:	
19.	Word Form	0.01
20.	Word Recognition	-0.3
21.	Meaning of Opposites	-0.2
22.	Picture Association	0.3
23.	Arithmetic Meanings	0.1
24.	Addition	0.0
25.	Word Usage	0.04

procedures employed. They are suggestive, however, and are reported as tentative results for heuristic purposes.

A word might be said about the values of F computed in this analysis. These differ slightly from t-values because of differing techniques of rounding, and because t-values were calculated by hand on all data available (N variable from 93 to 96), whereas F's were computed on only 93 Ss for whom data were completed on all 25 variables. The main differences in interpretive level were in SB IQ with Similarities in retarded group where the probability level dropped below .10, and on the ITPA Visual-Motor Association Test where the probability level dropped below .10. However, on two variables, the probability levels increased to the .01 level from a lower level. These were the ITPA Auditory-Vocal Association Test and the California Picture Association Test. The differences were only .045 on inferred t's from F on the IQ with; .031 on ITPA:AVA; .223 on the ITPA:MVA; and .213 on the California Picture Association.

The results of the multivariate analysis of normal experimental and control groups are presented in Table IV. As can be seen, they are all in the same direction as the larger analysis except for IQ with Similarities, where the weight on the 25x25 analysis is insignificant (-0.01) and the weight on the 5x5 matrix is barely so (.1). The major discrepancy is on S-D on SB where the 5x5 obtains a value of .9 and the 25x25 only .04. This seems explainable by the fact that the positive variance distributed itself among the other 20 variables in the major analysis, whereas in the 5x5 analysis it all summated in the first variable.

Table IV. Multivariance analysis of normal groups

Variables	Weight
1. No. of S.D. (S.B. L-M)	0.94
2. MA	-0.27
3. IQ - without	0.16
4. Sim-Diff	0.10
5. IQ - with	0.06

Conclusions and Implications

Combinations of these sets of data fall into four classes: (1) variables with positive weights on the multivariate analysis and positive t-values; (2) variables with positive weights on the multivariate analysis and negative t-values; (3) negative weights and positive t's; and (4) negative weights and negative t's. Those variables with significant weights (.1 or greater) and significant t values (.10 level or less) are considered to be of major importance while the two subsets; (significant t, nonsignificant weight; and nonsignificant t, significant weight) are regarded as of lesser importance.

Among tests which had positive weights and significant-t values were the following:

1. Similarities-Differences on Stanford-Binet
2. Corter McDonald Similarities-Differences test
3. Similarities on Stanford-Binet
4. Auditory-Vocal Association ITPA
5. Picture Association (California Achievement)
6. Arithmetic Meanings (California Achievement)

In addition, WISC Vocabulary had a significant t-value, but a negative insignificant weight (-.03) while two variables, SB IQ with similarities and visual motor association of the ITPA approached significance (.10 nonsignificant negative weight (-.01) while ITPA MVA had a slight positive weight (.03).

WISC verbal IQ with similarities was significant at the .05 level, and total WISC IQ approached significance (.10). It should be pointed out that the Similarities subtest accounted for almost all the differences observed. While the differences on the verbal scale in general were in a positive direction, performance scale scores were in the opposite direction with full-scale differences negligible.

Several conclusions seem justifiable from these data. The main effects of the training program center around the specific process taught where all variables serving as a measure of this increased significantly. This program seems also to have had an effect on associative tasks generally, extending to related reasoning areas. To a lesser extent, the program seems to have had a positive effect upon verbal ability or language improvement. There seemed to be a definite trend toward improvement in areas of measured intelligence although these differences are nonsignificant when similarities tests are partialed out.

The cost of such improvement is reflected in scores in which the control group improved more than the experimental group. These were WISC Arithmetic, California Meaning of Opposites. The latter two tests measure discriminations and processes that are quite different from those taught, and likely reflect the effect of a "normal" program in educable retarded classes. WISC arithmetic is slightly harder to explain, but several things are suggested. The main tasks at levels tested are to count, add, subtract, and multiply small numbers. The alternative types of computation are felt to be a factor; the somewhat mechanical nature of the task might be another factor. In general, there are suggestions throughout that "rote" type tasks,where learning modes were paramount,were somewhat interfered with by the training program.

For reasons cited earlier the multivariate analysis of variance results are to be interpreted with caution but an interpretation might have some heuristic value.

The group of variables having positive weights of .1 or more includes the following:

1.	SB IQ without Similarities	0.4
2.	California Picture Association	0.3
3.	WISC Information	0.2
4.	WISC Similarities	0.2
5.	ITPA Auditory Vocal Association	0.2
6.	California Arithmetic Meanings	0.1

The group of variables having negative weights of -.1 or more includes the following:

1.	WISC Coding	-0.5
2.	Stanford Binet Mental Age	-0.3
3.	WISC Picture Arrangement	-0.3
4.	California Word Recognition	-0.3
5.	WISC Arithmetic	-0.2
6.	WISC Block Design	-0.2
7.	California Meaning of Opposites	-0.2

The positive variables seem to abstract to verbal intelligence or the thing often called general intelligence where verbal factors and reasoning factors are combined, as in the English "g" factor. Bipolar to this are variables that involve fine discriminations, are involved somehow with chronological age (the only reason why MA would be included), and to a lesser extent seem to include tasks involving flexibility or "shifting" behavior, as well as speed tasks.

A word might be said about anomolies, where significance levels and loadings do not agree. S-B MA is an example. Here a nonsignificant positive t has a strong negative weight not only on the 25x25 analysis but also in the 5x5 normal group analysis. It is felt that chronological age is the culprit that makes the value negative, since it covaries with mental age, and all other intelligence variables are positive or inconsequential. If this part of the research were to be repeated, the author would eliminate the effects of (1) rate of mental growth and (2) effects of slight differences between testing dates which have unknown effects in this study. Two others with positive t's have only slight insignificant negative weights. These are WISC Vocabulary with a t of 2.159 (.05 prob.) and a weight of -.03 and SB IQ with Similarities (prob = 10) with a weight of -.01.

All the negatively significant t's have significant negative weights and are thus consistent, while most of the other variables are likewise consistent with the directionality, except for a number well within the obvious error range.

A word about the differences and similarities between retarded and normal groups. In general, the agreement is quite good on t-values except that the normal experimental group made slightly higher gains. This should be evaluated in view of the fact that no possibility existed for more precise balancing of teacher variable (the experimental teacher in the NE group was an exceptionally good teacher, in the author's opinion) and the fact that in one variable, IQ without similarities, the control group showed an IQ decline of one point on retesting. No regression phenomena were apparent, although it must be pointed out that the Normal E and C groups were both low average in intelligence with a mean at 92, so that possibilities exist there for regression effects, although to a lesser degree. The difference in loadings has already been remarked upon, and seems explainable by the positive variance attaching itself mainly to the first variable.

Discussion of Results

The hypothesis for improvement of experimental over control subjects in the similarities differences concept formation areas was generally strongly sustained. Not only were all similarities differences measures statistically significant, but closely related reasoning-like tests as the ITPA Association Tests were improved. A combined t of the 2 ITPA measures here of

1.590 attests to this, while the individual t-test scores of 2.344 and 1.504 for AVA and MVA, respectively, are significant at the .05 and approached significance at the $p < .10$ probability level, respectively. The Picture Association test of the California is likewise significant.

The hypothesis of improvement in intelligence independent of similarities and differences effects was not sustained. While all except one of the measures of this variable were positive, they only achieve significance or approach it when the similarities and differences items are included. It will be recalled that SB IQ with Similarities Differences included as usually given instead of alternate items yields a probability level of .10, while a level of .05 was obtained on this measure with the "normal" group. With the WISC, without similarities a nonsignificant change in a positive direction was matched by a nonsignificant change in a negative direction on performance measures for no appreciable differences on the total IQ. With Similarities subtest added, Verbal IQ as well as total IQ were significantly improved. Over-all improvement in achievement was again in the hypothesized positive direction with a positive F, but was not significant. The results here suggest that the program somehow interfered with discrimination learning, but aided association and attachment of meaning to arithmetic. Within the WISC, statistically significant improvement in vocabulary was somewhat negated by greater improvement in arithmetic by the control group.

It is difficult or unwise to attribute all the effects noted to the training program. Leaving out Hawthorne effects, the usual effects of any new program, there does seem to be a trend in the data that can only be attributed to experimental manipulation. Even the negative effects can likely be attributed to it since they seem somewhat the opposite of the things learned in the program. The process of conceptualizing taught was overlearned since the children observably tried to apply it to most everything. In this respect they seemed to become somewhat inflexible and cognitively dominated by the process taught them.

Implications

The major implication of this study is that this program does have effects deemed desirable in development, and remedies a frequently observed deficiency in retarded children *vis-a-vis* other children. Further, it seems to do so efficiently because a ten-hour program extending over twenty school days has measurable effects, not only in the area where training was given, but seems generalizable to other related cognitive areas, especially those in the domain of thinking or reasoning. While improvement in intelligence and achievement measures did not meet scientific criteria of effectiveness, the general trend of the data as a whole suggests slight improvement in these areas as well. In a practical endeavor such as education, one plays odds, and the odds seem definitely in favor of making one bet in this direction. The question of whether or not a one or two-point IQ differential is significant seems to be weighed in the balance with the ten hours taken to accomplish it. Put another way, a one extra month gain in mental age is evaluated against a one-month school program of one-half hour per day. An efficiency index for such a ratio would seem fairly high. "Raising the IQ" has recently become respectable again, after many abortive efforts in the 1930's followed by exaggerated scientific claims of others, and repeated failures following other theoretical modes since World War II. This goal will not be easy of accomplishment, and seems to the author to require first of all more concerted effort on the part of more investigators, fresh views of how to accomplish this, manipulation of the educational curriculum establishment, improvement in educational technology, and much more rapid communication of ideas among concerned investigators.

Risks seem fairly low, but should be dealt with. There are some suggestions that "rote" tasks are interfered with by this program, since control groups made greater gains. Whenever conceptualization occurs, it likely operates negatively, at least for a period, against discrimination and certain other rather specific types of learning. In some instances, program deficiencies in the area of differences might partially account for these effects, and overlearning of the process of conceptualization undoubtedly played a role. Another way of saying this is that the cognitive style developed was not always appropriate to all tasks.

The improvement generally in language skills and abilities seems noteworthy. While everyone agrees that language and thinking are interrelated and mutually supporting, traditionally we have thought that one should first improve language, then thinking would improve because we would have content and symbols to do the thinking job better. This research is suggestive of the fact that improvement in thinking improves language.[1] One cannot make too much of this, since the materials in the training program were so varied as to provide general "enrichment" and were so generally interesting that this program may be providing a strong contrast effect with more traditional methods, and undoubtedly introduced a number of new words into the pupil's vocabulary repertoire. With the shotgun approach used in this research such questions are moot, and it remains for the laboratory type investigator to tease out the details. It would, nonetheless, be exceedingly interesting to find out that the best course for improving language is by improving thinking or other modes of information acquisition, storage, and manipulation. This would bring about at least a minor revolution (with many a bloody battle) in the "language arts"

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[1] Another unpublished study of achievement in deaf Ss in which the author participated suggests the same thing.

Something should be said about the problems arising out of action research of this kind and the limitations of such sort of investigations. Frustrations of a scientific sort are many in a study such as this, and, to the investigator, seem to be always thwarting the achievement of significance or attenuating results. A number of these have been offered as explanations for various findings reported. If most of these seem to be alibis or excuses (it should be noted that teacher variance was used to explain partially the better-than-average improvement in the normal group), this follows the general line that such things are generally debilitating by increasing error variance, the ground function or base against which tests are made.

Cautions are in order in regard to many methodological considerations. Sampling problems are obvious. Gaining cooperation of school officials has not been difficult, although time-consuming; but one wonders if we are not in the box that investigators who use volunteers find themselves. Some sort of standard sample might obviate this difficulty as an REL three-state sample group. This would, however, compound the problem of travel. The real dearth of qualified examiners in various locations used is a problem that we have solved by traveling with a group of graduate assistants. Within various locales chosen, other sampling problems exist. Pupil and teacher variance are very difficult to control when one has very limited choices, as is generally true in a state with few large cities. The fact that groups were not statistically significantly different on various variables that might have had some influence was partly the result of intuitive balancing, but was partly a chance matter. Although the investigator's impression was that teachers were fairly well matched on usual grounds and on the basis of observation, this impression is necessarily impressionistic with the limitation that that implies.

Independence of examiners is another problem. It is not possible to conceal from examiners which groups were which (this would be very obvious as soon as several children were tested with the similarities-differences test). An independent group of examiners would likely be able to do the same thing. The only reasonable answer to this question is replication, preferably by skeptics. Hawthorne effects are unknown, but even control groups had considerably greater attention than they customarily receive. Examiners were generally popular people with both E and C groups of children employed.

One can, of course, describe an ideal experiment where groups and teachers were matched from a larger pool of classes, where some sort of special program was otherwise provided, where examiners did not know where Ss came from, etc., but this would seem not only economically costly, but with almost unsurmountable practical problems. With a broad approach such as ours, the various factors need to be replicated in a more highly controlled situation, as in an experimental school, and the details need to be investigated under rigid laboratory conditions. The teaching machine or computer would handle the problem of teacher variance, for example. It is rather more difficult to handle the dilemma of process-content, but some laboratory methods might be useful.

Some dissonance still exists in regard to a number of things in connection with the research. One is the finding that arithmetic scores on WISC were better in control groups than experimental groups. Other than chance, since with 25 variables one would expect about one to be significant on this basis, there is little to explain this result. The problem raised by a negative loading of mental age on the multivariate analysis is also puzzling and the only logical conclusion, that CA is the cause of this, seems a little unsatisfactory as an explanation. Less esoteric statistical techniques as hand factor analysis may yield variables more easily interpreted or understood and provide more workable hypotheses. Such a study is projected for further work during the coming year.

From the action view, four recommendations seem paramount. The first is that this program seems worthy of a larger-scale tryout at this point. This has been partially accomplished by provision for widespread application in schools in a continuation of this program underway this year. Still wider dissemination seems desirable and plans for this are projected. Concurrent with this is a need for further analysis of data, further refinement of testing and training procedures, and development of a theoretical base upon which larger problems can be anchored. The ultimate tests of any curriculum idea, whether emphasizing process as this one, or content as most do, are in their effects upon the child--his adjustment and functioning in meeting the problems of his world. How he solves problems, whether these relate to problems of his daily out-of-school existence now, how he achieves or accomplishes in school, and his later life adjustment, are the ultimate tests. Effort needs to be directed toward these crucial tests. If a retardate can become an effective problem-solver at his level, his potentials can be realized.

PHASE II

Phase II constituted a preliminary trial in an area called cognitive flexibility.

The major purpose of this phase of the research was to test the general hypothesis that special training procedures would be effective in facilitating the development of cognitive flexibility in educably retarded and bright normal children, and that these procedures would also improve performance on cognitive tasks that were independent of the training procedure employed. Cognitive flexibility was defined as the ability to perform shifts in three broad areas of cognitive functioning: perceptual flexibility, defined as the ability to reorder a stimulus array in several ways; conceptual flexibility, defined as the ability to reorder or categorize concepts in several ways; and spontaneous flexibility, defined as the ability to shift between ideas or concepts in the rapid production of cognitions.

Method

Subjects

The subjects were 32 educably retarded and 32 normal children who attended special education classes and kindergarten. Two classes of retarded children and two groups of kindergarten children were used.

All subjects were given the Stanford-Binet Intelligence Scale, Form L-M, and the Cognitive Flexibility Test (see Appendix A). The four groups were then matched on mental age and sex. In accordance with the matching procedure, 16 subjects were selected for each group; half were boys and half were girls. The means and standard deviations of the chronological ages, mental ages, IQ's, and CF total scores for each group are given in Table V. To ensure that the groups were adequately matched, an analysis of variance of the pre-test mental ages for each group was carried out. As Table VI shows, the resulting F-ratio was nonsignificant. Therefore, it was concluded that the groups were adequately matched. Since the mean IQ in the normal experimental group was 113.56, and that in the normal control group was 117.37, these groups must be considered as "bright normal" as opposed to "normal."

Table V. The mean and standard deviation of each pre-test variable for the retarded and bright normal groups

Group	N		CA	MA	IQ	CF
RE	16	$\bar{X}$	124.19	81.25	65.75	467.25
		s	14.09	10.19	5.86	140.85
RC	16	$\bar{X}$	126.00	80.56	65.06	417.25
		s	11.43	9.89	8.28	114.90
NE	16	$\bar{X}$	69.69	78.00	113.56	488.06
		s	4.53	6.78	11.59	131.03
NC	16	$\bar{X}$	69.81	80.56	117.37	501.56
		s	4.17	9.44	15.86	115.69

Table VI. The analysis of variance of pre-test mental ages for the experimental and control groups

Source	SS	df	MS	F
Means	98.56	3	32.85	0.389 ns
Error	5054.88	60	84.25	
Total	5153.44	63		

ns = not significant,-$p > .05$

The Test Battery

In a preliminary study, nine flexibility tests were constructed and were administered to 46 subjects. The subjects were educably retarded and first-grade students with a mean mental age of 82.11 months. The test data were subjected to a factor analysis and the hypothesis of a general factor was supported (see Appendix G).

Since the entire CF test battery of nine tests would require too much time to be conveniently used in the experimental situation, it was considered necessary to shorten the battery for experimental use. A total of five tests was finally selected. These tests were chosen on the basis of their factor loadings on cognitive flexibility, reliability, variation, intercorrelation, difficulty, ease of administration, and clinical validity. The tests finally selected were Stencil Design, Embedded Figures, Picture Anomalies, Object Sorting, and Tell About This (see Appendix E). The tests were administered in the order listed above. The CF total score was defined as the weighted sum of the scores on these five tests. The optimal weights were computed by multiple regression procedures. A description of the materials and procedures for each of these tests, as well as the scoring standards, is found in Appendix E.

The Training Procedure

The results of a preliminary factor analysis indicated that cognitive flexibility is a general factor manifested in a variety of cognitive tasks. At least three areas were isolated in which flexibility training might prove beneficial. The first of these was perceptual flexibility, which is defined as the ability to reorder or categorize a stimulus array in several ways. The second general area involved in flexibility was conceptual flexibility, defined as the ability to shift concepts; and the third area was spontaneous flexibility, which is defined as the ability to shift in ideational fluency.

Since the general goal of training was to establish a "flexibility set," it was necessary to use a large number of differenct exercises employing a variety of materials. It was believed that such a procedure would prevent the formation of simple response sets and would thus require the subject to shift across materials as well as within materials. To achieve such an arrangement, the three general areas of training were subdivided into two kinds of exercises for each area. For example, the types of exercises included in the perceptual area were figure-ground reversal and embedded figures. The types of exercises included in the conceptual area were similarities-differences and concept shifting. Those included in the fluency area were tasks in both structured and nonstructured fluency. A more complete description of specific exercises has been proveded in Appendix B. No specific type of exercise was repeated more than three times throughout training, and no specific type was given two days in succession.

The entire training program consisted of 42 exercises, with 14 exercises in each major area of training. The training program required approximately 30 to 45 minutes each day and lasted for 20 days. Positive reinforcement was given verbally and pplied liberally. Whenever possible, corrective feedback was immediate and was given on both group and individual bases. Frequent prompting of responses was employed as a device to facilitate responding, to maintain rapport, and to encourage attempts with difficult items. Review of concepts and procedures was held briefly before beginning each new exercise. During these brief review sessions, materials from previous exercises were used.

The Experimental Procedure

The experimental design was a 2x2 factorial with two treatment and two subject classifications. The two treatment conditions consisted of subjects receiving CF training and subjects not receiving CF training. The two subject classifications were retarded and normal.

All subjects were first pre-tested with the Stanford-Binet Intelligence Scale, Form L-M, and the Cognitive Flexibility Test. All tests were individually administered. Three experienced examiners gave the Stanford-Binet's, and the experimenter gave all the CF tests. Each Binet examiner tested approximately the same number of subjects in each group. The four groups were then matched on mental age and sex. The experimental groups received CF training in 30 to 45-minute sessions for 20 days. The control groups participated in their usual classroom activities but did not receive CF training. The retarded experimental group began training at 9:00 am, and the normal experimental group began training at 3:00 pm. The experimenter conducted the exercises each day except for two days during which the teachers had charge of training. Although only 16 subjects were selected for each group, the entire class participated in the exercises.

Thus, 19 children were present during training in the retarded group, and 23 were present in the normal group. The teachers remained in the room throughout training and assisted the experimenter in the distribution of materials and in giving corrective feedback.

At the end of training, all subjects were re-tested with the Stanford-Binet and the Cognitive Flexibility Test. Subjects were post-tested in approximately the same order in which they were pre-tested. To provide partial control for examiner error, the testing assignments for the post-tests were counterbalanced so that the Binet examiners tested different children from those they had pre-tested. As before, the experimenter administered all the CF tests.

Results

The means and standard deviations of the pre-test CF subtests and CF total scores for the retarded and normal groups are given in Table VII.

Table VII. The mean and standard deviation of each CF subtest and CF total score for the retarded and bright normal groups

Test	Retarded $\overline{X}$	Retarded s	Bright normal $\overline{X}$	Bright normal s	$\overline{X}_D$	t	
Stencil Design	8.50	5.29	10.37	5.72	1.87	1.357	ns
Embedded Figures	17.84	4.83	18.87	4.24	1.03	.906	ns
Picture Anomalies	23.44	6.98	24.12	4.22	.68	.471	ns
Object Sorting	17.28	6.55	22.03	8.49	4.75	2.504	**
Tell About This	18.62	5.00	20.78	6.06	2.16	1.555	ns
CF Total	442.25	129.07	494.81	121.78	52.56	1.675	*

ns = not significant, $-p > .05$
* = significant, $-p < .05$
** = significant, $-p < .01$

To test the hypothesis that the initial flexibility scores of the normal group were significantly higher than those of the retarded group, the mean CF scores for each group were compared by a t-test. The mean difference in CF total scores between the retarded and normal groups was 52.56. As Table VII shows, this difference was significant at the .05 level. Therefore, the null hypothesis of no difference in initial flexibility between the retarded and normal groups was rejected.

Although no _a priori_ predictions were made concerning normal and retarded group differences on the CF battery subtests, it was believed desirable to test these differences in an effort to explain the above finding and to provide additional experimental information. As shown in Table VII, the mean score for the normal group on each subtest was consistently higher than that for the retarded group. However, the only such difference that was significant was on the Object Sorting subtest. Although the differences observed for the Stencil Design and Tell About. This subtests approached significance, all other differences in subtest performance proved to be nonsignificant. It was therefore concluded that the differences between the retarded and normal group that were observed in the CF total scores could most reasonably be attributed to the differences between these two groups on the Object Sorting subtest and, to a lesser degree, to differences between the two groups on the Stencil Design and Tell About This subtests.

The hypotheses concerning the absolute change in CF and IQ scores were first tested by means of t-tests. In each case the null hypothesis tested was that the change in the particular test variable was significantly different from zero (two-tailed). Hypotheses concerning experimental and control group differences were tested by a 2x2 analysis of variance for each test variable. Since one subject in the retarded experimental group moved to another city during the post-test phase, it was necessary to estimate his post-test CF score in order to perform an analysis of variance for improvement in CF total score. The group mean for the post-test CF total score was taken as the best estimate of this score and was used in deriving the improvement score for this subject. Accordingly, 1 degree of freedom was subtracted from the total and error degrees of freedom in the computations of the analysis of variance.

The means and standard deviations of the change scores in CF total score and IQ are presented in Table VIII.

The mean change in CF total score for the retarded experimental group was 137.80, and the mean change for the normal experimental group was 152.94. Both of these means were highly significant (P < .001). The mean change in CF total score for the retarded control group was 31.87, and that for the normal control group was 52.69. The mean change in the retarded control group failed to approach significance; however, the change in the normal control group was significant at the .001 level.

Table VIII. The means and standard deviations of change scores for CF total score and IQ for the retarded and normal groups

Group		RE	RC	NE	NC
CF Total	N	15	16	16	16
	$\overline{X}$	137.800	31.875	152.937	52.687
	s	59.960	64.180	84.418	47.532
	t	9.052***	1.986 ns	7.247***	4.434
IQ	N	16	16	16	16
	$\overline{X}$	6.250	2.125	10.187	2.437
	s	5.739	4.856	12.029	8.981
	t	4.355***	1.750 ns	3.388**	1.085 ns

ns = not significant, -p > .05
** = significant, -p < .01
*** = significant, -p < .001

A summary of the analysis of variance of improvement in CF total scores is given in Table IX. As the table shows, the F-ratio for treatment effects was highly significant (P < .0005). However, the F-ratio for group effects as well as that for interaction failed to approach significance.

To test further the group effects, individual comparisons were made between the mean improvement for the retarded experimental group and the normal experimental group as well as between the retarded control group and the normal control group. The t-ratio for the experimental group comparison was .573, and that for the control group comparison was 1.474. Neither ratio approached significance at the .05 level. Therefore, one must conclude that the training program was effective in producing significant increases in flexibility in the experimental groups, and that these increases were significantly greater than those observed in the control groups. On the other hand, it must be concluded that there was no significant difference in improvement between the retarded and normal groups.

Table IX. The analysis of variance of change in CF factor scores

Source	SS	df	MS	F
Treatments	170,053.14	1	170,053.14	43.209****
Groups	5,166.02	1	5,166.02	1.313 ns
Interaction	129.39	1	129.39	0.033 ns
Error	232,198.56	59	3,935.57	
Total	407,547.11	62		

ns = not significant, -p > .05
**** = significant, -p < .0005

The mean increase in IQ for the retarded experimental group was 6.25, and the corresponding increase for the normal experimental group was 10.19. The mean for the retarded experimental group was significantly different from zero at the .001 level, while that for the normal experimental group was significant at the .01 level. The mean change in IQ for the retarded control group was 2.12, and the mean change for the normal control group was 2.44. Neither mean difference approached significance at the .05 level.

A summary of the analysis of variance of improvement in IQ is presented in Table X. As the table shows, the treatment effects were significant at the .01 level; however, the F-ratios for the group effects and interaction were not significant. In addition, individual comparisons between the mean improvement for the retarded experimental group and the normal experimental group as well as that for the retarded control group and the normal control group were not statistically significant. The t-ratio for the experimental group comparison was 1.671, and that for the control group comparison was .173. Consequently, it was concluded that the training program was effective in producing significant increases in the IQ's of the experimental groups, and that the mean increase in IQ for the experimental groups was significantly greater than for the control groups. Further, it was concluded that there were no significant differences in improvement in IQ between the normal and retarded groups.

Table X. The analysis of variance of change in IQ

Source	SS	df	MS	F
Treatments	564.06	1	564.06	8.033**
Groups	72.25	1	72.25	1.029 ns
Interaction	52.60	1	52.60	0.749 ns
Error	4213.09	60	70.22	
Total	4902.00	63		

ns = not significant, -p > .05
** = significant, -p < .01

Although no _a priori_ predictions were made concerning improvement on the subtests of the CF test battery, the differences in the pre-test and post-test scores of each subtest were tested to facilitate the explanation of the above findings and to provide more information concerning the differential test behavior of the experimental groups. The means and standard deviations of change scores for each CF subtest variable are given in Table XI. In general, the two experimental groups showed significant increases in all test variables with one exception, that the retarded experimental group failed to show a significant increase on the Stencil Design subtest. The retarded control group failed to demonstrate a significant change on all test variables except Stencil Design. The mean change on this subtest was significant at the .05 level. Likewise, the normal control group failed to improve on all test variables except the Picture Anomalies subtest. The mean change on this subtest was significant at the .001 level.

To ensure that the tests had met the criterion of adequate test-retest reliability, Pearson product-moment correlation coefficients were computed between the pre-test and post-test scores for each test variable. Both control groups (N=32) were used. These coefficients are presented in Table XII. The test-retest reliabilities for the CF total score and IQ were .904 and .970, respectively. The coefficients for the CF subtests ranged from

Table XI. The means and standard deviations of change scores for each test variable for each group

Group	N		Stencil Design	Embedded Figures	Picture Anomalies	Object Sorting	Tell About This	Total CF	IQ
RE	15	$\overline{X}$	1.133	3.267	5.467	11.733	9.866	137.800	6.250
		s	2.973	3.750	4.868	7.639	6.379	58.960	5.739
		t	1.477 ns	3.375**	4.439***	5.949***	5.990***	9.052***	4.355***
RC	16	$\overline{X}$	1.250	-.687	1.625	.937	- .875	31.875	2.125
		s	2.049	3.177	3.947	5.131	3.138	64.180	4.856
		t	2.441*	-8.65 ns	1.646 ns	.730 ns	-1.116 ns	1.986 ns	1.750 ns
NE	16	$\overline{X}$	3.250	3.187	5.750	10.562	6.937	152.937	10.187
		s	4.358	4.519	4.058	8.278	4.878	84.418	12.029
		t	2.984**	2.823**	5.671***	5.103***	5.691***	7.247***	3.388***
NC	16	$\overline{X}$	1.062	.562	3.125	2.062	- .062	52.687	2.437
		s	3.568	2.658	2.825	5.385	5.234	47.532	8.981
		t	1.190 ns	.846 ns	4.426***	1.532 ns	- .005 ns	4.434***	1.085 ns

ns = not significant, p >.05 level.
* = significant, p <.05 level.
** = significant, p <.01 level.
*** = significant, p <.001 level.

.725 to .890. Therefore, it was concluded that the tests had met the criterion of adequate test-retest reliability.

Table XII. The test-retest reliability of each test variable

Variable	Test-retest reliability
Stencil Design	0.866
Embedded Figures	0.890
Picture Anomalies	0.801
Object Sorting	0.786
Tell About This	0.725
Total CF	0.904
IQ	0.970

Discussion

The first objective of this study was to test the general hypothesis that normal children are more flexible than are retarded children of the same mental age. Inspection of Table VII indicates that the difference between the mean pre-test CF total scores for the normal and retarded groups was significant at the .05 level. However, when the performance of these two groups on the CF subtests was compared, significant differences were found only for the Object Sorting subtest. It was concluded that differences between the mean pre-test CF total scores for the normal and retarded groups could be attributed to differences between the two groups on the Object Sorting subtest and, to a lesser degree, to differences in the Stencil Design and Tell About This subtests.

These results suggest that differences in cognitive flexibility between normal and retarded children of the same mental age are due primarily to differences in their ability to shift concepts. Therefore, the results of this study support the conclusions of previous research showing greater difficulty in concept shifting among the retarded population as compared to the normal population (Bolles, 1939; Kounin, 1941; Kerstvedt _et al_., 1954; Haplin, 1958; Silverstein _et al_., 1963). Similarly, the general trend of the data also support previous research which indicates greater difficulty in figure-ground reversal and ideational fluency areas in retarded groups than in normal groups (Spitz and Blackman, 1959).

However, several limitations must be imposed on the generality of these findings. First, it may be argued that the normal group was not truly "normal" in the sense that the mean IQ's of the normal experimental and control groups were 113.56 and 117.37, respectively. Therefore, these groups must be classified as bright normal. Since the retarded and normal groups were approximately three standard deviations apart in IQ, the possibility exists that differences in flexibility between these two groups may be attributed to the greater general level of cognitive functioning in the normal as compared to the retarded group. A more critical test of the hypothesis might have examined differences in flexibility at several points on the IQ scale. Secondly, the retarded and normal groups were not matched for social class. The normal group was composed primarily of middle class children, and the retarded group of lower middle and upper lower class children. Since some research shows that middle class normal children shift concepts more readily than do lower class retarded children of the same mental age, it may be argued that the results reported above are the result of differences in social class (Zigler and de Labry, 1962). Thus, the finding that the normal groups employed in this study were more flexible than the retarded groups, when matched on mental age, must be considered equivocal.

Although the limitations cited above preclude a critical test of the "rigidity" hypothesis as advanced by Kounin (1941) and criticized by Zigler (1962), the results nevertheless support the general conclusion that retarded groups experience greater difficulty in shifting than do normals of the same mental age. In terms of the present study, these results do not imply that normals are not "rigid" or that retardates are "inherently" more rigid than normals of the same mental age. Rather, they do imply that educably retarded children experience greater difficulty in performing cognitive shifts than do bright normals of the same mental age; consequently, they demonstrate a greater need for flexibility training than do bright normals of the same mental age.

The second objective of this study was to test the general hypothesis that a training program designed to produce flexibility sets would be successful in increasing the cognitive flexibility of retarded and normal groups. As shown in Tables VIII and IX, this hypothesis was confirmed. Highly significant change scores were observed for both the retarded and normal experimental groups. On the other hand, the retarded control group failed to show significant improvement in CF total scores; however, the change in CF total scores in the normal control group was statistically significant. Nevertheless, the Analysis of Variance for improvement in CF total score shows the treatment effect to be highly significant and interaction to be nonsignificant (Table IX). Therefore, it may be concluded that the change observed in the normal control group was negligible.

Similarly, when the CF subtest pattern of improvement in the normal control group was analyzed (Table XI), it was apparent that the change in CF total scores in this group was largely due to change in the Picture Anomalies subtest. Consequently, the improvement in CF total scores for this group might be attributed to either random error or practice effects inherent in this subtest. Since the test-retest reliability for this subtest proved to be adequate ($r=.866$), the most tenable explanation for this change seems to be that of practice effects inherent in taking the test twice. Likewise, some improvement was noted in the Stencil Design subtest in the retarded control group; however, this change was not of sufficient magnitude to produce significant increases in the CF total scores. Since the test-retest reliability of these subtests and that of the CF total scores seemed adequate (Table XII), the sources of error were considered to be negligible.

In addition to the hypothesis that the training program would produce significant increases in flexibility in both experimental groups, it was also hypothesized that the retarded and normal groups would respond differently to training; i.e., the mean improvement in the retarded group would be different from that in the normal group. As Table IX shows, the group effect for the Analysis of Variance of improvement in CF total score was not statistically significant. Therefore, it was concluded that there was no difference between the normal and retarded groups in improvement.

According to the Lewin-Kounin theory of retardation, the retarded child is assumed to be dynamically different from the normal child of the same mental age in that the boundaries between his cognitive structures are less permeable, thus rendering his cognitive system less fluid and more rigid. It follows, therefore, that the retarded subject's cognitive system would be more resistant to change than the normal subject's, insomuch as change implies movement within the system. Thus, according to the

Lewin-Kounin position, one would predict that the normal group would show greater improvement following training than would the retarded group. Since this prediction was not verified, some doubt must be cast on the validity of the Lewin-Kounin theory of rigidity.

Basically, these results seem to imply that although retarded children demonstrate greater difficulty in performing cognitive shifts than do normals of the same mental age, the retarded child is nevertheless capable of producing the same change in his cognitive structure as the normal child. In this sense, therefore, he is not inherently more rigid than the normal child of the same mental age. Thus, although the Lewin-Kounin theory accounts for the initial differences in flexibility that were observed between the normal and retarded groups used in the present study, it seems incapable of explaining the changes in flexibility that were observed following cognitive flexibility training.

The third major objective of the present study was to test the hypothesis that the effects of CF training would generalize to other areas of cognitive functioning and thus would facilitate improvement on cognitive tasks which were independent of training. Highly significant improvement scores in IQ were observed for the experimental groups (Tables VIII and X). Similarly, the Analysis of Variance of improvement in IQ shows a highly significant group and interaction effects. It was concluded that the CF training program was successful in increasing the general level of cognitive functioning in the experimental groups.

These results may be interpreted as providing support for the assertion that retarded and normal children can be trained to adopt flexible approaches in problem-solving. Furthermore, the results support the conclusion that "flexibility sets" can be established which facilitate performance on a variety of cognitive tasks. In this respect it may be argued that such sets seem to have a high degree of generality. This implies that such training is more "basic" in terms of cognitive functioning than procedures which stress the acquisition of specific skills. Operating under such sets, the individual learns not only what responses are appropriate or inappropriate but, more importantly, how to modify his behavior. Thus, he becomes more efficient in problem solving.

Unfortunately these conclusions must be interpreted in the light of several limitations. First, as discussed previously, the retarded and normal groups were not matched for social class. Secondly, the retarded groups were not classified according to etology. Consequently, it is impossible to discuss these results in terms of possible differences arising from endogenous or exogenous diagnostic groups. Similarly, it should be reiterated that the normal groups were, at the time of this study, actually functioning in the "bright normal" range. Since the retarded and normal groups were, on the the average, functioning at levels three standard deviations apart in Binet IQ, limitations should be imposed on the generalization of these results to groups functioning at other levels. Fourth, since the physical requirements of the experimental situation permitted no contact with the control groups during the training period, the possibility exists that some of the improvement that was observed in the experimental groups might be due to the establishment of greater rapport with these groups during the training period. And last, since it was impossible to keep a daily record of the subjects' performance during the training program, one cannot attribute improvement in specific tests to training in the area measured by these tests. Consequently, some information must be considered to be lost regarding the predictive validity of specific CF tests.

Although the conclusions of this study are somewhat restricted by the limitations discussed above, it is nevertheless believed that the results of this study have several implications for special education and elementary class curriculum development for future research in cognitive development, and for the remedial treatment of learning disabilities. First, the finding that educably retarded and normal kindergarten children can learn to adopt flexible approaches to problem-solving suggests that an overemphasis on repetitive drill techniques in school curricula is not only unnecessary but may, in the long run, be detrimental to future cognitive development. The results of this study demonstrate that retarded and normal children are not only capable of more complex cognitive activity than is assumed by repetitive methods, but also that they improve in general cognitive functioning following practice in these activities. Consequently, since flexibility training has been shown in this study to generalize to other cognitive areas, it may be fruitful to investigate the possibility of applying flexibility training as a part of the curriculum for educably retarded and elementary school children. Likewise, since the results demonstrate that educably retarded children are capable of more complex cognitive activity than they are usually assumed to be able to perform, efforts should be made to integrate these findings in the light of current developmental theory.

Additional research concerning both the CF test battery and CF training program may prove to be of significant value in explaining differential developmental processes in retarded and normal children of the same mental age. Furthermore, it is believed that such research would provide greater insight into the reasoning and learning processes of both groups, thus providing valuable theoretical and practical information.

Finally, it is believed that the results of this experiment may have immediate applications for the remedial treatment of learning diabilities in retarded subjects. Perhaps one reason that remedial training programs in cognitive processes have not been developed is that adequate diagnostic instruments have not been available.

It is believed that the results of this study demonstrate that theoretical constructs such as flexibility, as defined by a factorized test battery, may be of significant value in explaining individual differences on a variety of cognitive tasks and in providing descriptive models for successful educational intervention.

PHASE III

The objective in Phase III of this project was to develop a test and training program in the productivity-responsiveness area. This test has been developed and is appended in Appendix E. The major areas involved in this function, as measured, are speed of performance, fluency, and productivity of ideation, while responsiveness is inherent in both in getting children to respond to this particular test situation. The training program has been developed to mirror these functions and follows the general sequence of the test (see Appendix C).

It should be noted that a preliminary tryout of these materials was employed early in the summer, and has since been rather extensively revised. No analysis has been made of these data at this point, and it is planned that this program will be tested this year.

SUMMARY

Whether or not cognitive training, defined as process rather than content, in selected modes of thinking and reasoning is a trainable function and, if so, whether or not this training will be generalizable to other cognitive domains was the central focus in this research. Hypotheses of improvement in processes of similarities-differences concept formation (SD) as the effect of a training program in this area were tested, as well as hypotheses concerning improvement in other broad cognitive areas as intelligence, achievement, and reasoning. In a pilot program similar hypotheses were tested in an area called cognitive flexibility (CF), defined as the ability to perform shifts in three broad areas--perceptual flexibility, conceptual flexibility, and spontaneous flexibility. In the SD area a previously developed test and training program was tested in four classes of educable retarded and one "normal" class. Control groups were employed. A test and training program in the CF area was developed and was tested in two classes, one retarded and one bright normal, for effectiveness utilizing matched controls. A test and training program was developed to a tryout stage in the productivity-responsiveness (PR) area. Change scores between pre-testings and post-testings were the fundamental data collected, and tests of significance between experimental and control groups were made in the case of SD and CF programs. A multivariate analysis of variance was performed on the SD data.

In the SD study, statistically significant differences between experimental and control groups in favor of the experimental groups on eight variables included:

1) Number of similarities and/or differences items on the Stanford-Binet,
2) The Corter-McDonald Similarities Differences Test
3) Similarities on the WISC
4) Vocabulary on the WISC
5) The Auditory Vocal Association Test of the ITPA
6) The Picture Association subtest of the California Achievement Test
7) The Arithmetic Meanings subtest of the California
8) Verbal IQ of the WISC with similarities included.

Several other variables approached significance (.10 probability level) in the same direction. These were SBIQ,

including similarities-differences items: The Visual Motor Association subtest of the ITPA; and the Total WISC IQ with similarities test included. On the other hand, three variables showed significantly greater improvement for the control groups. These were (1) WISC Arithmetic, (2) California Word Recognition, and (3) California Meaning of Opposites. Similar positive results were found in the normal experimental and control groups utilizing five variables except that SBIQ with similarities-differences items was statistically significant.

The multivariate analysis of variance was felt to have heuristic value only. In general, F-ratios from this analysis were in close agreement with calculated t-values. Regression weights in a bipolar linear array arrived at in this analysis include SBIQ (without similarities), California Picture Association, WISC Information, WISC Similarities, ITPA Auditory-Vocal Association, and California Arithmetic meanings with positive loadings versus WISC coding, Stanford Binet Mental Age, WISC Picture Arrangement, California Meaning of Opposites at the negative pole. This was interpreted as a verbal-reasoning, "g"-like factor versus a discrimination, age related, speed, and flexibility group. The analysis with normal groups was similar with somewhat differing weights, the most striking of which was a much higher positive loading on Similarities-Differences items on the SB.

To summarize, the hypothesis concerning improvement in the area of concept formation was strongly sustained, with gains in associated areas of reasoning and, to a lesser extent, verbal areas. The hypothesis of change in other cognitive areas as intelligence, and achievement was not sustained, when similarities-differences effects were eliminated. While there was a general trend in favor of the E group, differences were quite small.

In the Cognitive-Flexibility study, significant improvement was found in that area as well as significant improvement in intelligence in retarded as well as bright normals of the same mental age. Effects were attributed to experimental manipulation of the training program. These results are regarded as tentative due to the small sample employed.

These results seem encouraging. Certainly training programs oriented to process can improve these functions with retarded children and perhaps have favorable effects in other cognitive areas. The question of "raising the IQ" again scientifically respectable, is moot, but hopes exist.

It would seem appropriate, considering the small amount of time consumed in classroom situations with these programs, to recommend further tryout and study, both in more controlled situations and in extensions to larger groups. These programs not only seem promising but also appear to be efficient.

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APPENDIX A

THE SIMILARITIES-DIFFERENCES CONCEPT FORMATION TRAINING PROGRAM

COGNITIVE TRAINING

SIMILARITIES AND DIFFERENCES

First Day[1]

The training program began with an introduction to the procedures to be followed throughout the four-week period. All _Ss_ as a group were introduced to the concepts of similarities and differences. The following ideas were demonstrated by use of colors and were discussed: "both," "same," "alike," "not alike," "different," and similar". The _Ss_ were told that these concepts would be used throughout the training in comparing concrete and abstract similarities and differences.

The basic concept dealt with was that of similarities and differences of color. First, colored circles of the same size in red, yellow, blue, and green were compared and contrasted. Then colored bows of the same size were shown using various combinations of colors and comparing different hues of blue, green, red, and brown. Colored blocks of the same size were contrasted and compared, as were various geometrical figures of the same colors. The _Ss_ were taught to tell when colors were alike, when they were similar in hue, and when they were different.

Second Day

The beginning portion of the training period consisted of a brief review of the concepts of "both," "each," etc., discussed the previous day. These words were printed on sheets of paper and given to the _Ss_. New illustrations were demonstrated using colored bows. _Ss_ were shown six square, pink blocks of six different sizes and were told how the blocks were similar and how they were different. Next, _Ss_ were shown the following figures colored with crayons on 3 by 5 in. cards, and they were asked to give likenesses and differences:

1. Two blue circles, both alike in size and color.
2. One green and one yellow circle of the same size.
3. Four orange squares and four brown squares of the same size.
4. Three yellow and one black square plus three red and one purple of the same size.
5. Two green, one purple, and one orange square of the same size.

Likenesses and differences also were pointed out in the following pictures pasted on 3x5 cards:

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[1] The writer apologizes for the use of colloquialisms. The material in the training program, designed for children, is presented in their language.

1. Two ducks - one brown and one white.
2. Two horses - one black with white legs and one solid black (a racer and a work horse).
3. Two sheep - one with a black face and legs and one solid white.
4. Two pigs - one black with white spots and one black with a white streak.
5. Two cows - one white and black; one brown and white.
6. Two chickens - one white and one brown.
7. Four red cardinals - one smaller than the other three.
8. Four squirrels - three brown and one gray - all the same size.
9. Four cats - three gray and one white - all the same size.
10. Four rabbits - three small white ones and one large brown one.
11. Four cats - three small brown ones and one large brown one.
12. Four collies - three large dark ones and one small white one.

Ss were then given a sheet on which were printed five rows of four circles each. They were told to color with crayons the circles in the following manner:

1. All circles colored alike in the first row.
2. One circle colored different from the other three circles in the next row.
3. Two circles alike in color, then two additional different colors.
4. Two circles alike of one color and two alike of another color in the fourth row.
5. All circles colored different in the last row.

Ss were allowed to pick the colors they wished as long as they followed the correct procedure. Ss exhibited their colors to the other Ss.

Third Day

The concept used to teach similarities and differences was that of various shapes. First, likenesses and differences of shapes were illustrated on the blackboard. The figures included:

1. Two rhombi with differing angles, a rectangle, and a square - all four-sided figures.
2. Four circles of various sizes.
3. Three triangles with varying angles and lengths of sides.
4. Four types of stars.
5. An eight-sided figure, a six-sided figure, and a five-sided figure.

Figures drawn with black crayon on 3x5 cards were shown, and Ss were asked to note similarities and differences. The figures included were:

1. Two circles alike
2. A square and a circle
3. A rectangle and a square
4. A square and a rhombus
5. Two oval figures alike
6. An oval and a rectangle.

Ss were presented shapes of various types in wood. One set of shapes was brown and one set was white. The Ss were asked to match the following figures from the two sets:

1. Cross
2. Star
3. Square
4. Circle
5. Flattened circle
6. Rectangle
7. Six-sided figure
8. Rhombus

Ss were then given many assorted shapes, some of which were rather abstract designs, and asked to find shapes that matched.

Two printed sheets were given to Ss. They were asked to pick out, in each row, any figures that were different. Several rows had all figures alike, several had different shapes, and several had different sizes.

Fourth Day

Ss were taught to observe similarities and differences in various colored forms. First, 3x5 cards on which were colored the following designs were shown:

1. Two red ovals and one red rectangle.
2. Two purple triangles and a purple octagon.
3. Two yellow circles, one yellow octagon, and one red octagon.
4. Three green circles with inner yellow circles, and one yellow circle with an inner green circle.
5. One brown rhombus, one brown square, one brown rectangle, and one orange square.
6. One purple circle, one black circle, one black octagon, and one black triangle.

Then Ss were shown a series of larger 5x7 cards with printed designs of the following shapes and colors, and were asked to note similarities and differences in colors and shapes:

1. Two green triangles and one yellow diamond.
2. Two red squares and a blue triangle.
3. Two blue circles and a black triangle.
4. Two yellow half-circles and a red triangle.
5. Two red triangles and a yellow rectangle.
6. Two red circles and a blue box.
7. Two large yellow squares and a small red square.
8. Two small red squares and a large blue square.
9. Two blue squares and a red circle.

10. Two large blue circles and a red diamond.
11. Two red triangles and a large yellow square.
12. Two large red circles and a small red circle.
13. Three green triangles and a green square.
14. Three red squares and a red diamond.
15. Four blue triangles and a red one.
16. Four blue squares and a blue triangle.
17. Four red and blue rectangles and one red rectangle with blue stripes.
18. Two blue circles, two white circles outlined in blue, and one red circle.
19. Four green and white checkered patterns; one additional one with one less white square.
20. Four sets of parallel lines of the same length, one set with a short and a long line.
21. Two X's, two circles, and one straight line.
22. Four green and white checkered patterns; one additional one with the colors reversed.
23. Two sets of three green squares, two sets of three green circles, and one set of two green squares.
24. Two red triangles, two red ovals, one red circle.
25. One circle, one triangle, one rhombus, one five-sided figure, and one diamond.

Forms drawn on the blackboard with colored chalk were used to illustrate similarities and differences of color and shape. The figures were:

1. Two purple triangles, one purple circle, and a yellow circle.
2. Three red squares and a white rectangle.
3. Two blue squares, a blue rhombus, and an orange rhombus.
4. A yellow square, a yellow rectangle, a yellow oval, and a red hexagon.

The Ss were then shown wooden blocks of assorted sizes, colors, and shapes. Comparisons were made according to the size, color, and shape and to the design pasted on top. The blocks were of two thicknesses (thick and thin), of two shapes (square and circle), of four colors (two shades of red and two shades of blue), and had two types of designs pasted on top (a yellow circle and a yellow triangle).

Printed sheets previously checked for differences in form were colored. Ss were told to color all like forms alike and all unlike forms differently.

Fifth Day

Similarities and differences of color and form again were studied. Modeling clay of various colors (blue, green, yellow, white, pink, and orange) was shaped by the Ss into various like and unlike forms. Molds for animal shapes also were used, and similarities and differences among the animals were discussed. Ss were then asked to think of as many objects in their environment as possible that were of the following shapes: circles or round, rectangular, square, and triangular.

Sixth Day

The concepts emphasized this period related to similarities and differences were those of concrete letters and numbers. First, letters printed on 3x5 cards were shown and Ss were asked to note similarities and differences. The letters consisted of:

1. SV VS
2. To To
3. Cc Cc
4. Ww WW
5. VvvV
6. SSss
7. EFHG FEHG FEHG
8. BDRQ BPRQ BDRQ
9. SOTV SOTV SOTV
10. CYW CYW YWC
11. VSW VSW
12. TCO COT

Then numbers printed on the same size cards were shown. These were:

1. 372 372 872
2. 169 169 169
3. 137 731 731
4. 1065 1065 1065
5. 56983 56963 56983
6. 15249863
   15249863
   15429863
   15249863

Similar lists of numbers and letters were printed on sheets and Sswere asked to underline the different items.

Seventh Day

The concept related to similarities and differences dealt with in this lesson was that of abstract figures. First, Ss were taught to understand what is meant by "abstract figures". An example of similarities and differences in abstract figures was illustrated on the blackboard. Then several examples drawn on 3x5 cards were shown and discussed. These consisted of figures with lines drawn in opposite directions or off-center, figures with triangles and circles different in some portion, and various patterns that were changed in some manner. Three printed sheets then were given to Ss. The first sheet consisted of 10 sets of 3 abstract figures, and the Ss were asked to pick out which of the 3 was different from the other 2. The second printed sheet consisted of 7 sets of 1 abstract figure in a box to the left with several abstract figures in a large box to the right of the first box. Ss were asked to pick the one figure from the large box which was exactly like the lone figure in the small box. The third printed sheet consisted of four sets of abstract figures from which Ss were asked to select the one that was different. The sheet also had 10 pairs of figures, some of which were alike and some of which were not alike. Ss were asked to check those that were alike and put a cross by those that were different.

Eighth Day

A variety of concrete objects was used to illustrate similarities and differences. These objects consisted of:

1. One small white bow and one large pink bow - all bows.
2. Red ball, red saucer, red apple - all red.
3. Three pieces of material - all material.
4. Two types of sea shells - both sea shells.
5. Book matches and safety matches - both matches.
6. Hammer, pliers, screwdriver - all tools.
7. Large spoon, small spoon - both spoons.
8. Spoon, fork, knife - all eating utensils.
9. Matches and cigarette lighter - both produce fire.
10. Glue and scotch tape - both stick.
11. Scissors and Girl Scout knife - both cut.
12. Pipe and cigarette - both for smoking.
13. Two candles - one red and one white - both candles.
14. Beatle card, playing card, baseball card - all cards.
15. Whistle and bell - both make noise.
16. Sugar lump and candy - both "sweets".
17. Pencil, pen, chalk - all write.
18. Box and envelope - both hold things.
19. Eyebrow pencil and lipstick - both makeup.
20. Battery and receptacle - both help supply energy.
21. Bubble blower, baseball, and baseball bat - all toys.
22. Crayon and brush - both used for coloring.
23. Green crayon, green card, green knife - all green.
24. Paper towel, piece of paper, envelope - all paper.

Printed sheets were given to Ss. Two sets of pictures of certain objects such as dog houses, bottles, ducks, etc., were drawn either exactly alike or were drawn differently. Ss were asked to decide if the two ducks, for example, looked exactly alike in the two pictures. Ss colored alike those pictures that were identical and colored differently those pictures that were different.

Ninth Day

Pictures of objects, pasted on 3x5 cards, were used to illustrate similarities and differences of objects and sizes. The pictures were of the following nature:

1. Two identical pictures of a drum and a ball.
2. Two identical pictures of a top and a ball.
3. One picture of a top and a drum and one picture of a drum and a ball.
4. One picture with a top on the left and a drum on the right. One picture with a drum on the left and a top on the right.
5. Three salt and pepper shakers - one with a different design from the others.
6. Three cars of a train - one car different.
7. Two identical pictures of portions of a train.
8. Two different pictures of portions of a train.
9. Three glasses - two alike in design.
10. Three plates - two alike in design.

11. Three train engines - two alike.
12. Three houses - two alike.
13. Three watches - two alike.
14. Three wrapped packages - two alike.
15. Three wheels - two large and one small.
16. Three wheelbarrows - one without a handle.
17. Three sets of books - one set arranged differently.
18. Three pencil sharpeners - one with the handle turned in a different direction.
19. Three sets of three letters - one set reversed.
20. Three squirrels and one rabbit.
21. Three dogs and one cat.
22. Two tall pitchers and one short pitcher.
23. Two cups alike and one different.
24. Four mailboxes - two of the same size and two smaller.
25. Four sacks - two the same size and two larger.
26. Four trees - two the same size and two larger.
27. Four houses - two the same size, one larger, and one smaller.
28. Four buckets - two the same size, one larger, and one smaller.
29. Four baskets - two the same size, one larger, and one smaller.
30. Four barns - two the same size, one larger, and one smaller.
31. Four wheelbarrows - two the same size and two larger.

Printed sheets were given Ss. They were instructed to match the object on the left side of the page with the appropriate same size object from a choice of four assorted sizes on the right side of the sheet.

Tenth Day

Pictures pasted on 3x5 cards were used to illustrate the similarities and differences of animals and of methods of motion. The picture consisted of dogs, squirrels, and cats running, sleeping, sitting, and jumping, and of children standing, skating, crawling, hopping, and running.

Pictures cut out of magazines also were used to teach similarities and differences. These pictures consisted of such objects as:

1. A football and a basketball.
2. Four glasses with drinks.
3. Two types of fish.
4. An outboard motor and water skis.
5. Cosmetics of several types.
6. Various camping equipment.
7. Soft drinks in bottles and cans.
8. A train and a helicopter.
9. Two planes.
10. Various types of watches and clocks.
11. A string and a brass musical instrument.
12. Pictures of playing cards and dice.
13. A television set and a record player.

14. Several shapes of glasses.
15. Several types of fruits.
16. An old car and a new car.
17. Several types of paper products.
18. Several types of food.
19. Two public servants - a teacher and a policeman.
20. A group of brides' pictures.
21. Several types of emblems.
22. Many types of beans.
23. Outdoor lawn equipment.
24. Several paintings of Jesus.

Eleventh Day

Again, pictures were used to illustrate similarities and differences. First, several 3x5 cards on which pictures were drawn or pasted were shown. These consisted of:

1. Two flowers alike.
2. Flowers and trees.
3. A comb and a brush.
4. Forks, one of which was different.
5. Spoons, one of which was different.
6. A toy boat, a ball, and a car.
7. An apple and grapes.

Pictures cut from magazines also were used. These pictures consisted of:

1. Cereals in bowls.
2. A man fishing and one "skin-diving".
3. Many types of animals - included a bird, a dog, several members of the cat family, and water animals.
4. Two racing cars.
5. Car products such as gasoline, oil, etc.
6. An organ and a band.
7. Many types of seafoods.
8. Many bridges.
9. Scenes with waterfalls.
10. A pipe, a cigar, a cigarette, and a cigarette in a holder.
11. Two arrangements of roses.
12. Many helpful workers such as a nurse, a doctor, a plumber, a teacher, etc.
13. Many types of meats.
14. Two types of onions.
15. Many types of foods.
16. Ice in a glass and ice on trees.
17. A washing machine and a dishwasher.
18. Two pictures showing strong emotion - teenagers laughing and a grandfather hugging his grandson.
19. Children of many nationalities.

Printed sheets were given to Ss. They were given instructions to check those objects alike and put an X mark by those that were different.

Twelfth Day

Similarities and differences in pictures again were illustrated during this day's program. First, pictures pasted on 5x7 cards were shown. These consisted of:

1. A roast, a loaf of bread, celery, and a high chair.
2. A squirrel, a turtle, a dog, a rabbit, and a doll.
3. A bed, a chest, a table, a sofa, and a cup.
4. A glass, a plate, a bowl, a pitcher, and a cap.

Ss were required to pick out the different object and tell why it was different.

Pictures cut from magazines then were shown. These consisted of the following:

1. The American flag and the Canadian flag.
2. Four types of fruits.
3. The moon and the United States.
4. A turkey and gelatin.
5. Four men in uniform.
6. Several types of desserts.
7. Indian art.
8. A doctor in his mask and gown and a girl nursing her dog.
9. Several electrical appliances.
10. A horse and buggy and a car.
11. Two tires.
12. Several types of moving vans, trucks, trailers, etc.
13. A man and a woman working.
14. Several dogs.
15. Two women in lace dresses.
16. Two drinks - kool-aid and coffee.

Printed sheets were given to Ss with instructions to pick out of the four objects drawn on the right the one of which the object to the left was a part. For example, a candle was pictured on the left, and Ss were given the choice of the following: a light bulb, a picture, a birthday cake with candles, and a pie.

Thirteenth Day

More complex and abstract objects were used during this training session to illustrate similarities and differences.

First, various sizes, shapes, and values of American and foreign coins were used. Illustrations consisted of:

1. Several types of dimes, pennies, nickels, etc.
2. Several shapes of coins.
3. Several colors of coins.
4. Different coins of the same value.
5. Different pictures on coins.
6. Different types of metals in coins.

Stamps of many countries with different values, sizes, shapes, and colors were illustrated.

Buttons also were used to give examples of similarities and differences. Characteristics compared included colors; number of holes in the buttons; size, shape, and type of material from which the button was made.

Printed sheets were given to Ss to mark. They were instructed to circle the correct one of four items on the right to correspond with the item on the left side of the page.

Fourteenth Day

The topic used to discuss similarities and differences in this session was that of like and unlike sounds, such as words that rhymed or began or ended with the same sounds. First, pictures pasted on 3x5 cards were shown. The articles pictured were:

1. Soap and rope.
2. Stamp and lamp.
3. Sun and gun.
4. Sweater and platter.
5. Pinwheel and pencil.[1]
6. Rattle and rabbit.
7. Top and cup.
8. Nest and dress.
9. Boat and bird.
10. Cup and can.
11. Hose and rose.
12. Shirt and skirt.
13. Crown and clown.
14. Coat and cone.
15. Bowl and boat.
16. Truck and block.
17. Chain and plane.
18. Pen and hen.
19. Rooster and toaster.
20. Hen and hat.
21. Duck and sock.
22. Sheep and shoe.
23. Cow and owl.
24. Pig and pin.
25. Turkey and telephone.
26. Lamb and leaf.
27. Colt and comb.

Printed sheets that included pairs of things having like sounds (such as a cone and a bone) were given to Ss. They were told to name the sounds that were alike. Ss were also asked to name the following:

1. An animal that rhymed with "bat".

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[1] Customary southern pronunciation.

2. An animal that rhymed with "three".
3. A color that rhymed with "pound".
4. An article of clothing that rhymed with "sat".
5. Something that rhymed with "bowl".

Fifteenth Day

Verbal similarities and differences were the concepts taught during this training session. First, Ss were asked to give differences for the following items, which were printed on 3x5 cards:

1. A golf ball and a grapefruit.
2. A pie and a cake.
3. A bus and a motorcycle.
4. A Negro and a Chinese.
5. A cat and a duck.
6. A man and a woman.
7. A square and a triangle.
8. Coca-cola and hot chocolate
9. A prince and a princess.
10. Black and white.
11. A bicycle and a wagon.
12. A puppy and a dog.
13. A kite and a sailboat.
14. A snake and a lizard.

After the differences were discussed, Ss were asked to give similarities between the two items. These, too, were discussed.

A printed sheet was given to Ss along with instructions to circle which one item out of four was not similar to the other three. The pictures were:

1. A brief case, a trunk, a lamp, a pocketbook.
2. Presents gift-wrapped, a jack-o-lantern, an umbrella, and a Christmas tree.
3. A football player running with the ball, a man sawing, a man hoeing, a man fixing a flat tire.
4. A faucet, a waterfall, a glass of ice water, a safety pin.
5. An owl, a frog, a crab, a swan.

Sixteenth Day

More verbal similarities and differences were discussed during this training session. The pairs of words were printed on the blackboard and read by E to the Ss. The pairs were as follows:

1. Fork-spoon.
2. Lamb-kitten.
3. Umbrella-raincoat.
4. Diamond-ruby.
5. Dog-sparrow.
6. Clarinet-trumpet.
7. Wagon-automobile.
8. Nickel-quarter.
9. Apple-pear.
10. Feet-hands.
11. Mud-sand.
12. Tree-grass.
13. Heart-lungs.
14. The letter "Z" - December.

Differences were discussed first for all the pairs and then similarities between the pairs were discussed.

A printed sheet was given to Ss with instructions to circle the object pictured that was not similar to the others in the same group. The pictures were as follows:

1. Baby birds in a nest, a baby, an old man, a chick hatching.
2. A telephone, a baseball glove, a ball, a kite.
3. A tricycle, a bell, a wheel chair, a scooter.
4. A hammer, a wrench, a saw, a smoking pipe.
5. A vase of flowers, a bracelet, a necklace, a ring.

More difficult verbal similarities and differences were discussed. The pairs of words were printed on the blackboard as follows:

1. Rectangle-octagon.
2. Silk-nylon.
3. Indian - white man.
4. Measles-mumps.
5. Daily paper - magazines.
6. Farming-mining.
7. Bird-plant.
8. Heavy-light.
9. Saw - knife blade.
10. Cooling-freezing.
11. Heating-cooking.
12. Cooking-freezing.
13. Dog-wolf.
14. School-dictionary.
15. Sick-well.
16. Wood-gasoline.
17. Chair-dresser.
18. Sleep-water.
19. Protestant-Jew.

First differences for all pairs were discussed, followed by a discussion of the similarities.

A printed sheet of similarities and differences of words was given Ss. They were told to mark the one wrong word that did not go with the other three words in each group. The words were as follows:

1. Strawberry, grape, fan, cherry.
2. Swing, lamp, baseball, see-saw.
3. Radio, bus, tractor, boat.
4. Lamb, donkey, dime, rooster.
5. Triangle, square, circle, monkey.

Eighteenth Day

A review of the various types of concepts used to teach similarities and differences was begun. Similar types of large cards on which were printed words and designs were used. The cards presented the following material:

1. Three peppermint stick candies and one baseball bat.
2. Two red plates and a red fork.
3. Five rabbits and a squirrel.
4. Three yellow rectangles and two yellow ovals of different sizes.
5. Five geometric designs - two pairs similar, one entirely different.
6. One triangle, one tree, two triangles, two trees, three

triangles.

7. Two blocks, the number "2," four blocks, the number "4," the number "3".
8. The numbers 1, 3, 5, 7, 15.
9. The letters F, g, H, I, J.
10. Five cups - one without a handle.
11. Two raccoons, two beds, a glass.
12. Five tables - one missing a leg.
13. Five stick figures - one different.
14. Five abstract figures - one different.
15. Five children's faces - one without an eye.
16. Five apples - one a different size.
17. Grapes, apples, oranges, an ear of corn, a banana.
18. An airplane, a ship, a blimp, an umbrella, a motorboat.
19. A hammer, a screw, a saw, a nail, a screwdriver.
20. Words: potato, movies, peas, bicycle, television.
21. A parrot, a tree, a robin, a cabbage, a dog.
22. Five different abstract figures - four similar in direction.
23. A bird's nest, a bird, a goldfish, a goldfish bowl, a rat.
24. A tomato, corn, okra, onion, lettuce.
25. A field of wheat, a field of tobacco, the words: North Carolina, Kansas, Oregon.

Nineteenth Day

This training session consisted of a review of material used in the similarities and differences studies. The following objects were presented:

1. Five pink blocks of different sizes.
2. Five bows of different shades of blue.
3. Three yellow circles and three green circles.
4. Different colored blocks of the same size.
5. Different shaped objects of clear plastic.
6. Two stars of different sizes and materials.
7. Figures of different shapes and different colors.
8. Four red objects - an apple, a saucer, a candle, a ball.
9. Three round objects - an apple, a saucer, a ball.
10. Three tools - a hammer, a screwdriver, pliers.
11. A spoon and a fork.
12. A pipe and a cigarette.
13. Toys - a ball and a bat, a jack, a bubble blower.
14. Money - several sizes, shapes, and amounts.
15. Stamps - several sizes, colors, shapes, and amounts.
16. Buttons - several sizes, colors, shapes, having different number of button holes and of different materials.

Next, items were presented on 3x5 cards. They were illustrative colored figures, plain figures, letters, numbers, and similar and different pictures that had been used during the training program. Examples of each type of concept illustrated by 3x5 cards were selected and reviewed. No new cards were shown.

Twentieth Day

On this day, the final day of the training program, the majority of the period was spent in putting together the workbooks made by Ss. The workbook was composed of all the printed sheets used during the training. Ss who had been absent for a day or several days were given printed sheets for the days they missed, and E helped them to complete all the work for their booklets. All Ss also individually reviewed the various concepts studied by the use of a teaching machine. A short program consisting of eight sets of three choices was drawn on a sheet of paper. Ss were instructed to press the button for one out of three items that was different from the other two. A light came on if the correct button was pressed. The eight sets of choices consisted of the following:

1. A hexagon and two octagons.
2. AJPMLTOZ, AJPMLTOZ, AJPMITOZ.
3. 169854273, 169842573, 169842573.
4. Drawings of a hand, a foot, and a hand.
5. A yellow trapezoid slanted to the left, a red trapezoid slanted to the right, a red rectangle.
6. Drawings of a cup, a plate, a spoon.
7. The words: cat, dog, cat.
8. The words: spring, July, summer.

APPENDIX B

A DESCRIPTION OF THE COGNITIVE FLEXIBILITY TRAINING PROGRAM

THE COGNITIVE FLEXIBILITY TRAINING PROGRAM

First Day

Exercise 1: Similarities-Differences

Materials. The materials for the first exercise consisted of a red rectangle, a yellow square, a red circle and a yellow ellipse which were cut from colored cardboard sheets. A two-foot square easel was used to present the stimuli.

Procedure. The subjects were shown the rectangle and circle and were asked to tell how they were alike and how they were different. The concepts of alike, same and different were discussed and illustrated by presenting all combinations of the four objects. The concept of classification according to similarity was introduced by asking the subjects how the experimenter could put two of the objects which were alike together on one side of the easel and put the other two objects which were alike on the other side. After this was accomplished, the experimenter then explained that there was another way to do it which was different from the way they were previously arranged. The subjects were then asked how they could rearrange the items so as to put them together in a new way which was different from the way they did it the first time. After this procedure was accomplished, all the concepts of similarity and difference, as well as the principles of classification and shift, were reviewed.

Exercise 2: Figure-Ground Differentiation

Materials. Two 8½x11 inch stimulus cards were used. On one card the number one, cut from white construction paper, was pasted on a black background. On the other card the black-white configuration was reversed.

Procedure. The subjects were shown the first card and were asked to observe how that figure, as well as most of the figures they had seen, appeared against some background. The concepts of figure and ground were further illustrated by holding up various objects in the room in front of different backgrounds and then encouraging the subjects to tell which parts composed the figure and which the ground, *e.g.*, chalk in front of a blackboard. The subjects were then told that it was sometimes fun to change the figure and ground and to see what happened. The subjects were then shown the first card followed by the second card. Throughout the demonstrations, the concepts of figure, background, changing and reversing were stressed.

Exercise 3: Cancellation

Materials. Each child was given a sheet of 8½x11 inch paper on which fifty triangles, squares and circles appeared in random order.

Procedure. Subjects were instructed to go down the sheet one row at a time, crossing out all of the circles as fast as they could, and to raise their hands as soon as they had finished. The same procedure was employed for the triangles and squares. In each case the concept of speed was stressed.

Second Day

Exercise 4: Similarities and Differences

Materials. Each subject was given a set of four cards with a picture of one of four objects on each card. The pictures used were those of a large truck, a small truck, a large pumpkin and a small pumpkin.

Procedure. The second day of training began with a brief review of the concepts of similarity and difference. All appropriate comparisons of objects were made by having the subjects hold up two cards and tell how they were alike and how they were different. The principles of classification and shift were illustrated by having the subjects sort the objects into two piles on their desks such that two objects in each pile were alike in some way. The subjects were then instructed to sort them according to another principle. After each subject had successfully sorted the objects according to two principles, the concepts of similarity, difference and shift were reviewed.

Exercise 5: Embedded Figures

Materials. The materials for this exercise consisted of three 4x4 inch transparent plastic cards on which one of three figures appeared. When placed one on top of the other, the resulting figure was a square with the corner points connected by diagonals which intersected a second circumscribed square. Each part, as well as the entire figure, was also reproduced on an 8½x11 inch stimulus card.

Procedure. Perceptual training began with a brief review of the concepts of figure and ground by using the stimulus cards that were presented during exercise 2. The subjects were told that in addition to the figure-ground aspects of a figure, one could break a big figure down into its parts and note how the parts fit together to make a whole figure. The subjects were then instructed to separate plastic overlays and to spread them out over their desks. They were asked to look at each part separately and then to place the cards back together to make a whole figure like the original design. After each subject had successfully reproduced the figure, the experimenter held up the stimulus card for each part and asked the subjects to find that part and to hold it up. When all subjects had successfully located the part and had examined it, the experimenter then asked them to replace the part and to observe how it went with the others to make the whole figure. All combinations of the parts and each part taken separately were then reviewed.

Exercise 6: Word Naming

Procedure. The subjects were told the purpose of this part was to name as many words as they could in three minutes. They were told that any words they thought of would be appropriate, *e.g.*, "happy," "chair," "house," and "school." All subjects were encouraged to respond as fast as they could. During periods of no response, the experimenter and the teacher named one or two words each and then encouraged the group to do likewise. After three minutes the experimenter suggested that the subjects see how many children's names they could say in three minutes. The subjects were told that the experimenter would go down the rows of desks and that each subject would have a turn to say one name. The subjects were also told that they could not say their own names and that they could not say the same name twice. The experimenter then passed around the room twice, calling on each subject individually. Subjects who gave repetitive responses were encouraged to think of a different name.

Third Day

Exercise 7: Figure-Ground Differentiation

Materials. The materials for this exercise were a box of crayons for each subject and three designs reproduced in duplicate on separate sheets of 8½x11 inch paper. The designs employed were a circle, a diamond and a four-pointed star. Each design was enclosed by a four-inch square and appeared on the top and bottom halves of the page.

Procedure. The exercise began with a review of the concepts of figure and ground by using the first example from exercise 2. Each subject was given a box of crayons and a copy of the circle design. Subjects were then instructed to color the circle red and to leave the background white. A completed example was held up to insure that the subjects understood the task. After this was performed by all subjects, the experimenter asked the group how they might make the figure look different with the same colors. After all subjects had completed the reversal task, the experimenter handed out copies of the diamond design and instructed the subjects to color the figure one color and the background another color by using the red and yellow crayons. When all subjects had completed the first design, they were told to reverse the figure and ground colors. The same procedure was followed for the last design with the exception that the subjects were allowed to choose their colors.

Exercise 8: Similarities and Differences

Materials. The materials consisted of sixteen 8½x11 inch stimulus cards on which two pictures were either pasted or drawn. The pictures were the following:

1. Two circles - one green and one red,
2. Two squares - one large and one small,
3. Cat - dog,
4. Car - boat,
5. Orange - banana,
6. Red rectangle - yellow square,
7. Penny - nickel,
8. Knife - fork,
9. Squirrel - rabbit,
10. Drum - horn,
11. Football - basketball
12. Pen - pencil,
13. Sun - moon,
14. Cup - glass,
15. The letters "A" and "B,"
16. Blue triangle - yellow triangle - both with red circles.

Procedure. The experimenter held up each card and asked the subjects how the two pictures were alike and how they were different. All appropriate similarities and differences were discussed and illustrated.

Fourth Day

Exercise 9: Embedded Figures

Materials. The materials required for this exercise were four 8½x11 inch sheets on which various objects were embedded within a more complex configuration. On the first two sheets, animal forms and faces were embedded in landscape scenes. On the second sheet, a house and a car were embedded within several geometric designs.

Procedure. Each subject was given copies of the materials and was told that several faces were hidden on the first page and that he could find them by breaking the whole picture down into its parts. The concepts of part, whole and part-whole relationships were then reviewed by using the materials from exercise 5. Subjects were instructed to put a circle around each face with crayons after they had found it.

The same procedure was followed for the embedded animals example. Subjects who had difficulty in finding the various objects were prompted. After completion of the first two pages, the subjects were told that a car had been hidden on the third page, and were instructed to fill in the car after they had found it. Confirmation was accomplished by placing a plastic overlay over the subject's drawing and allowing him to check its accuracy. The same procedure was used for the embedded house.

Exercise 10: Class Naming

Procedure.. In the first part of this exercise, the subjects were instructed to name as many animals as they could in three minutes. In the second part they were asked to name numbers. The same procedure as in part 2 of exercise 6 was employed in this exercise.

Fifth Day

Exercise 11: Analogies

Materials. Fourteen 2x2 matrices composed of various geometrical figures were used. The matrices were reproduced on three 8½x11 inch sheets of paper. Four matrices appeared on the first two sheets and six on the last (see Figure 7).

Procedure. Each subject was given a copy of the materials and was asked to observe how each large square was composed of a group of figures in which one part was missing. Subjects were instructed to fill in the appropriate part so as to make a complete set of figures that all went together in some way. In each case the correct response was elicited by prompting. For example, in the first matrix the experimenter

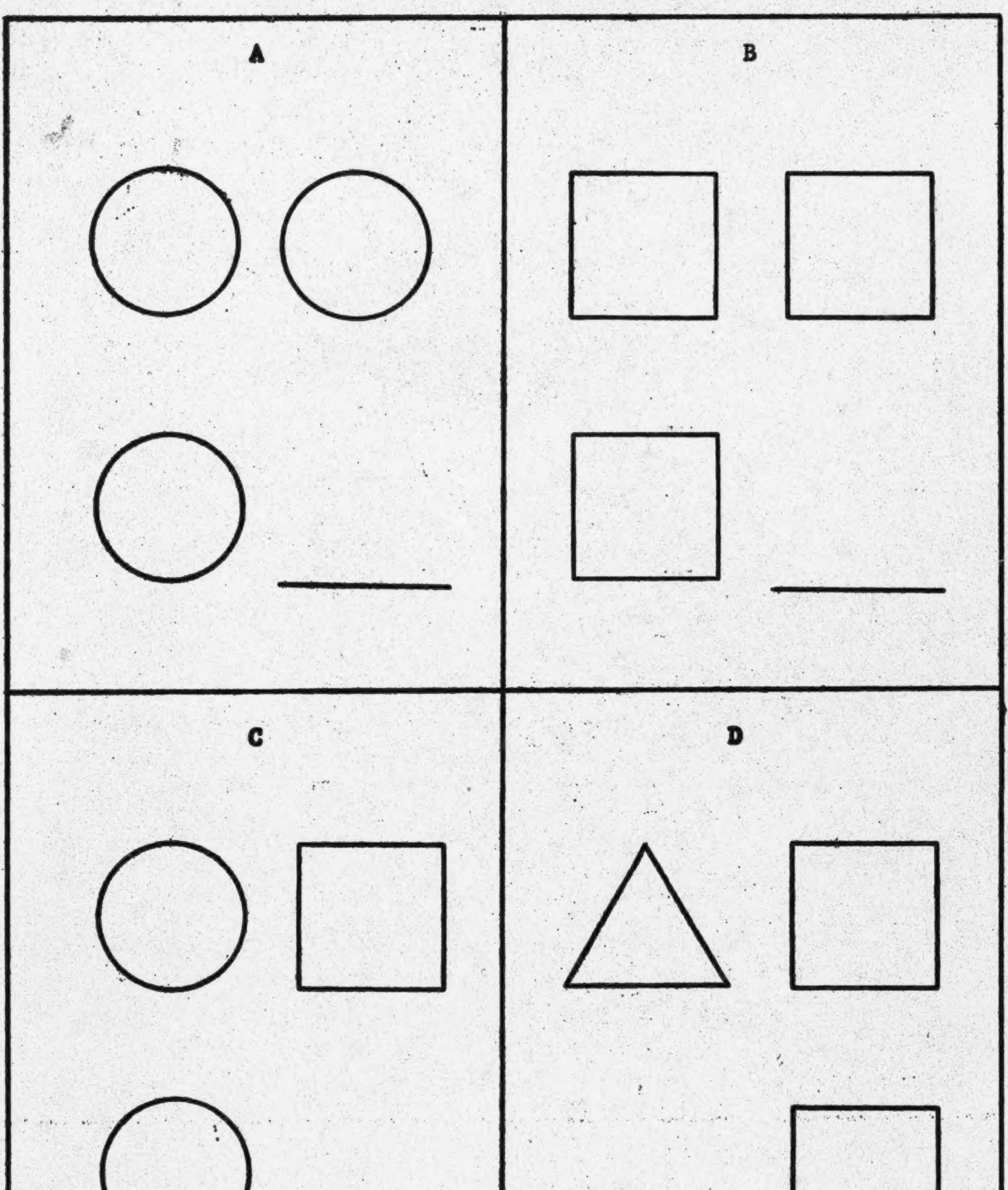

Figure 7. Exercise 11: Analogies

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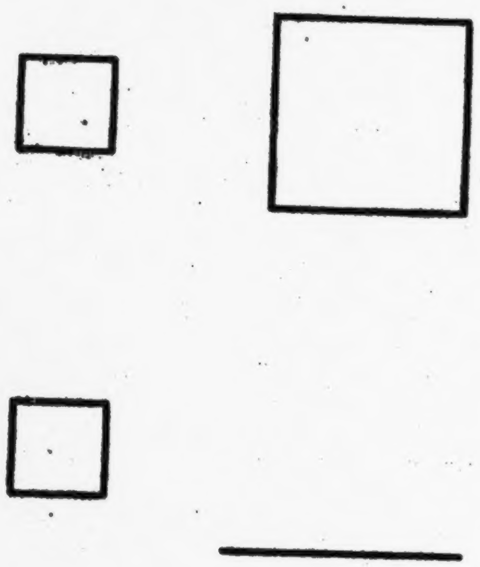

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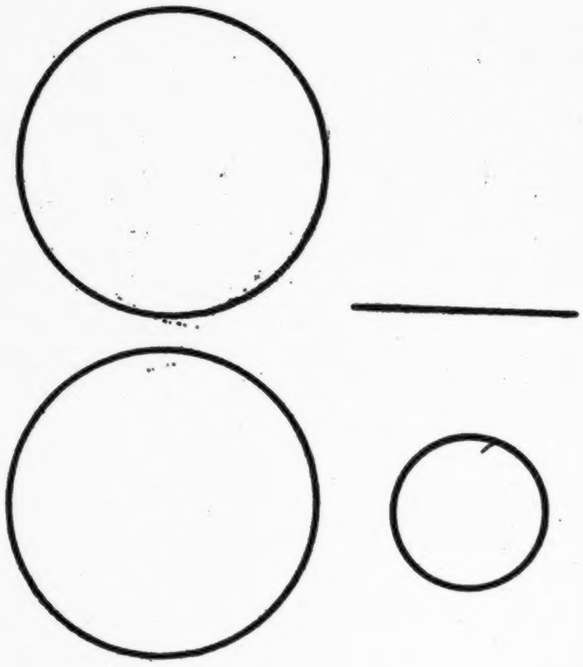

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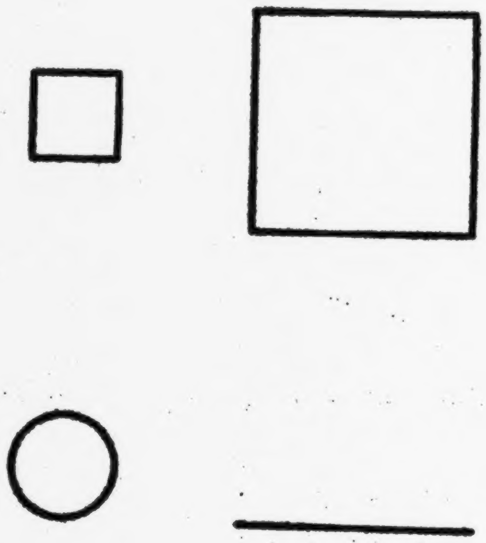

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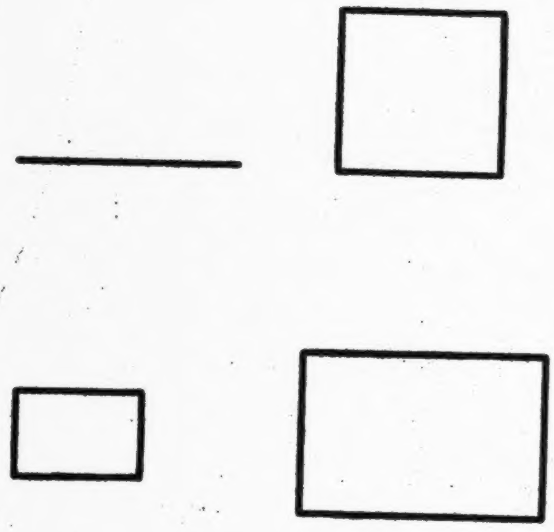

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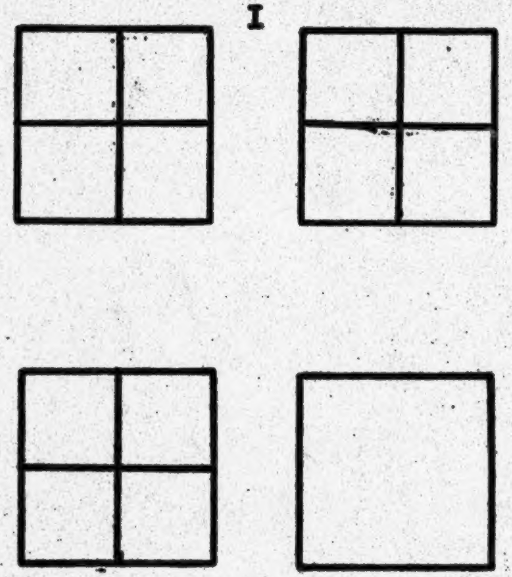

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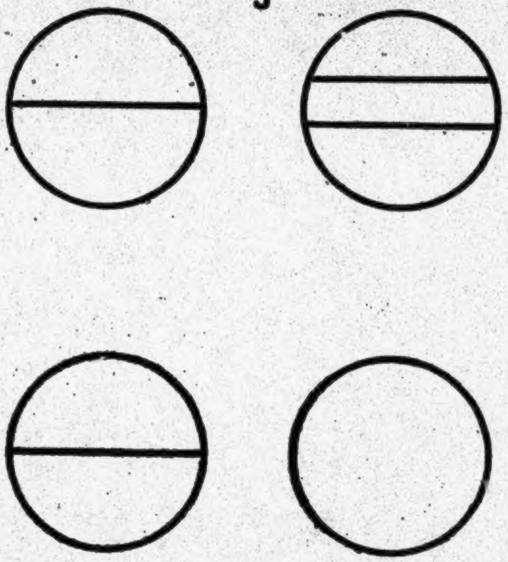

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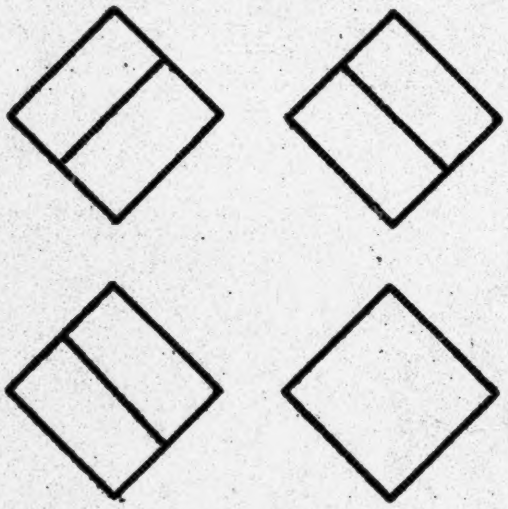

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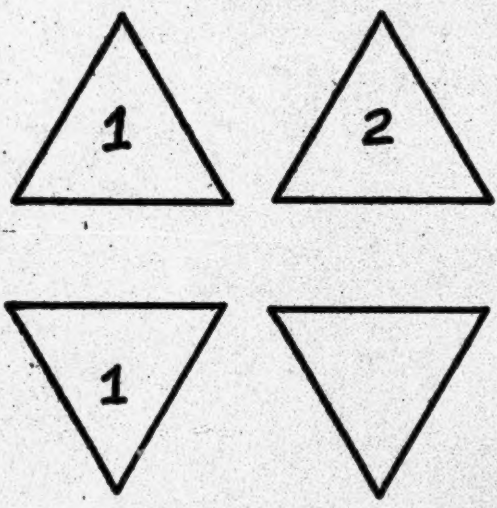

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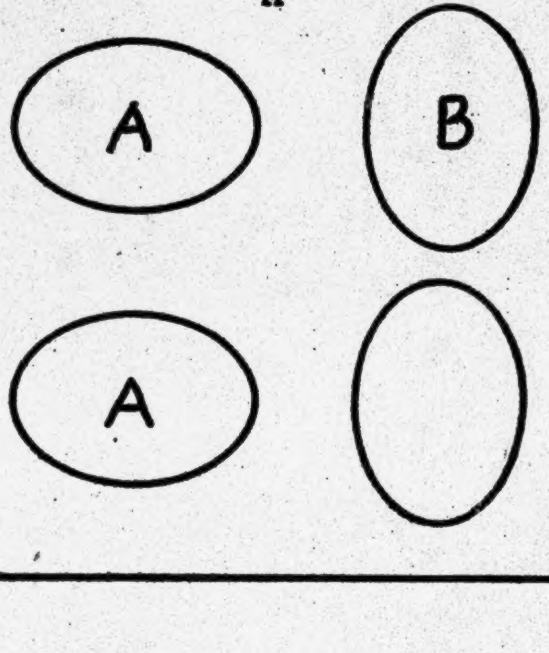

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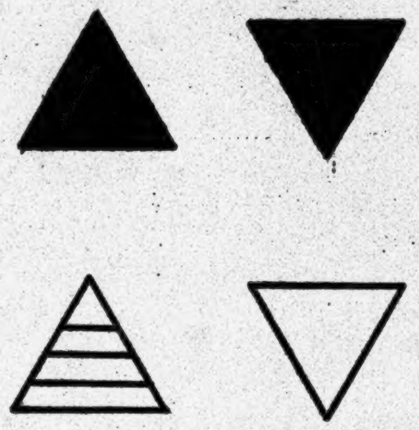

proceeded by saying, "Here we have a circle, here we have another circle, and here we have a third circle. What kind of figure goes in here?" After each subject had correctly filled in the blank space, the experimenter reviewed the relationship before going on to the next item. The same prompting and confirmation procedure was utilized for all other items.

Exercise 12: Tell About This

Materials. Three stimulus objects were used in this exercise. The first was a 5x10 inch card on which five triangles, two circles and a rectangle of different colors appeared in a complex geometrical arrangement. The second object was a book, and the third was a baseball bat.

Procedure. The experimenter held up the objects one at a time in the order given above and asked the subjects to name as many things about them as they could. The procedure for this exercise was essentially the same as that for exercises 6 and 10.

Sixth Day

Exercise 13: Opposites (Extremes)

Procedure. The subjects were told that the experimenter would name a word, and then they would be required to name the word that meant the opposite. The examples given were the following: up-down, night-day, and big-little. If the subjects did not respond after a reasonable period of time, the experimenter supplied the opposite word and proceeded to the next item. The following twenty opposites were used:

1. First-last,
2. Dark-light,
3. Work-play,
4. Hard-soft,
5. High-low,
6. Right-wrong,
7. Old-new,
8. Wet-dry,
9. Top-bottom,
10. Happy-sad,
11. Hot-cold,
12. Black-white,
13. Stop-go,
14. Boy-girl,
15. Tall-short,
16. Add-subtract,
17. Sweet-sour,
18. Strong-weak,
19. Sleep-awake,
20. Lost-found.

Exercise 14: Figure-Ground Reversal

Materials. The materials consisted of three abstract figures reproduced in duplicate on three 8½x11 inch sheets of paper, one 8½x11 inch stimulus card for each figure and a black crayon. The first figure was the letter "T" circumscribed by a four-inch square. The second was an L-shaped configuration circumscribed by a 4x5 inch rectangle. The third figure formed a diamond with a square in the center and was circumscribed by a 2x4 inch rectangle. The stimulus cards for each figure illustrated the appropriate figure-ground relationship with black parallel lines drawn in either the figure or ground aspects of the configuration.

Procedure. Training began with a brief review of the concepts of figure, ground and reversal by using the materials from exercise 7. The experimenter held up the stimulus card for the first design and asked the subject to put stripes on the background and to leave the figure (the letter "T") white. After all subjects had successfully accomplished this task, the experimenter asked them how they might reverse the figure and the background. The subjects were then instructed to reverse the figure-ground configuration. Confirmation was given with the appropriate stimulus card. The same procedure was followed for the other two designs. In each case a black-white configuration with parallel lines was used.

Seventh Day

Exercise 15: Coding

Materials. The materials for this exercise consisted of two 8½x11 inch sheets of paper on which appeared a 5x6 matrix composed of ellipses turned either vertically or horizontally in random order.

Procedure. Each subject was given a copy of the first sheet and was instructed to draw a horizontal line through a vertical ellipse and a vertical line through a horizontal ellipse. The first row was completed by the experimenter as an example. The subjects were instructed to work as fast as they could and to hold up their hands when they had finished. After all subjects had completed this task, they were given a second sheet and were told to reverse the sequence they had just completed. The same instructions and procedure were used for this part.

Exercise 16: Embedded Figures

Materials. The materials for this exercise were three 8½x11 inch sheets of paper on which circles, triangles and squares were embedded within a more complex geometrical configuration (see Figure 8).

Procedure. Each subject was given the first sheet and a box of crayons and was told that the complex figure was composed of circles, triangles and squares, and that he could find all of the smaller figures by breaking the larger figure down into its parts. The concepts of part and whole were then reviewed by using the materials from exercise 5. Subjects were then instructed to find all of the circles and to color them red. The same procedure was used for the other two sheets with the subjects' being allowed to select the colors.

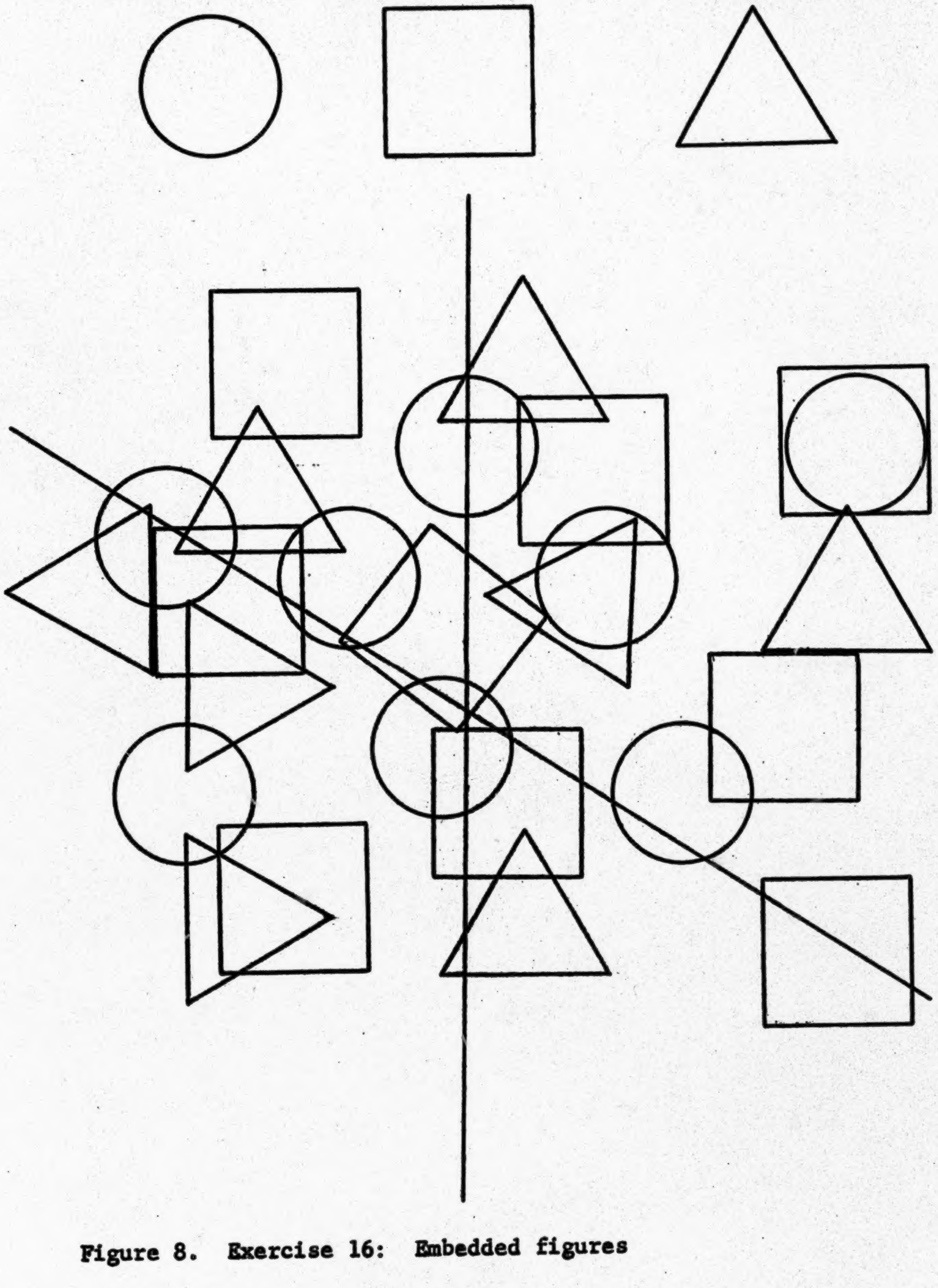

Figure 8. Exercise 16: Embedded figures

Eighth Day

Exercise 17: Analogies

Materials. The materials for this exercise were eighteen 2x2 matrices composed of various geometrical figures, letters and numbers. The matrices were reproduced on three 8½x11 inch sheets of paper (see Figure 9).

Procedure. Same as that for exercise 11.

Exercise 18: Rhymes

Procedure. Subjects were instructed to name as many words as they could which rhyme with "rat." They were told that a rhyme was a word that sounded like another word, and that "bat" and "sat" rhymed with "rat." Rhymes were supplied from a prepared list when the subjects failed to respond. All responses were reinforced regardless of their correctness; however, subjects giving a response not rhyming with "rat" were reminded that rhymes were words that sound alike. After all subjects had exhausted their repertoire for the first word, the exercise was repeated with "red" and "sad" as the stimulus words.

Ninth Day

Exercise 19: Opposites (Extremes)

Procedure. The procedure for this exercise was the same as that for exercise 13. The opposites employed were the following:

1. Night-day,
2. Left-right,
3. Good-bad,
4. Small-large,
5. Grandmother-grandfather,
6. Front-back,
7. Summer-winter,
8. Fall-spring,
9. East-west,
10. Cry-laugh,

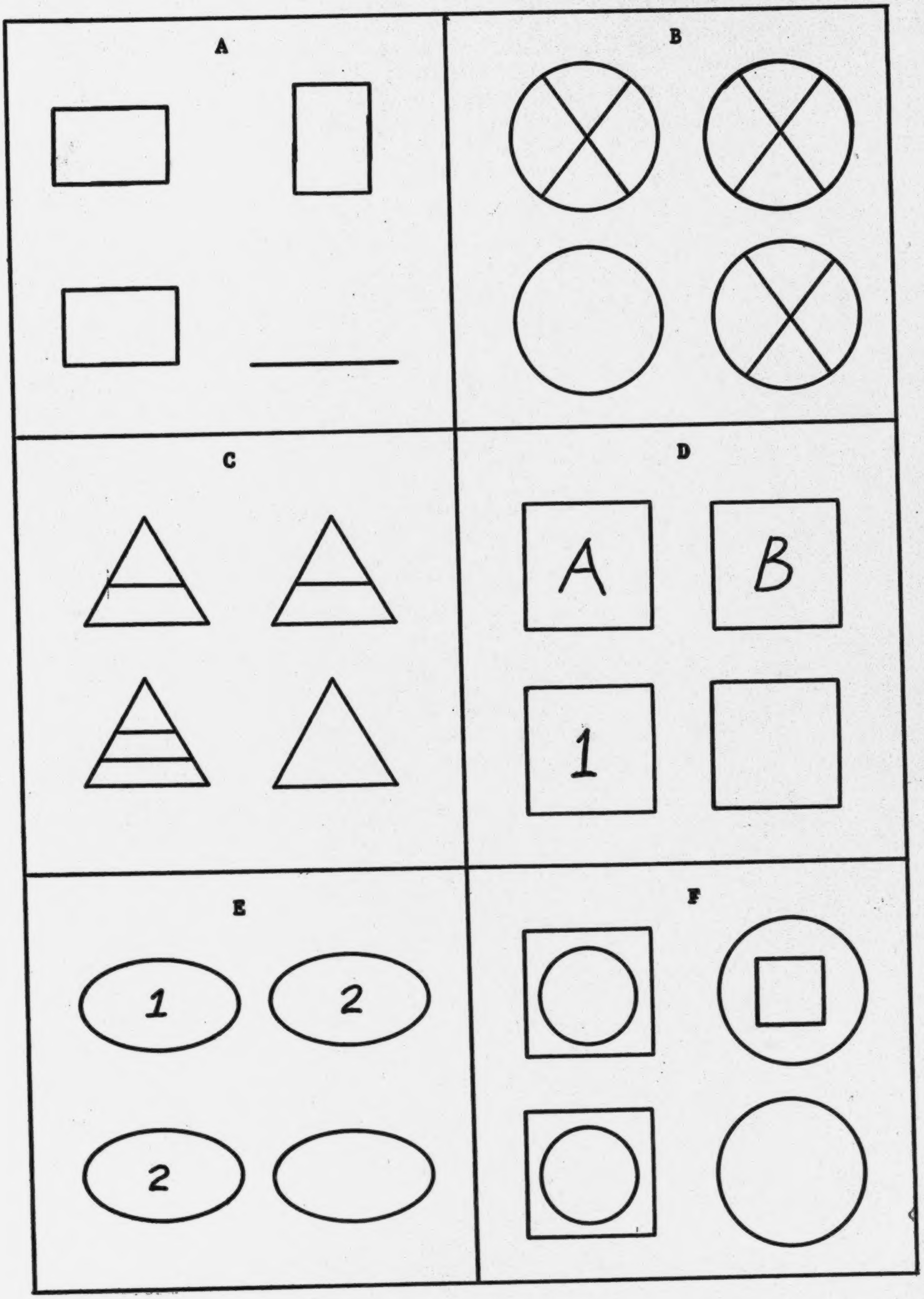
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Figure 9. Exercise 17: Analogies

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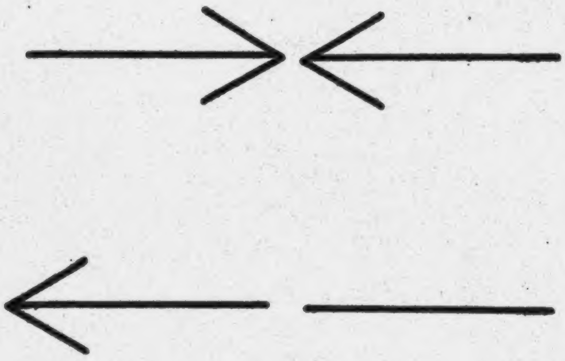

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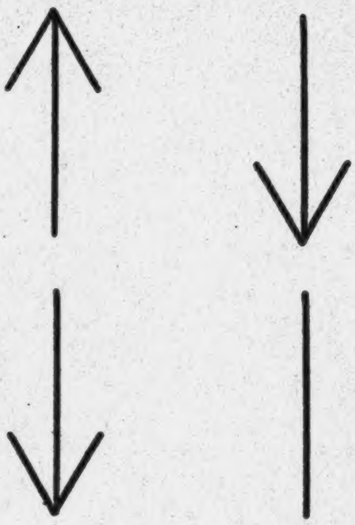

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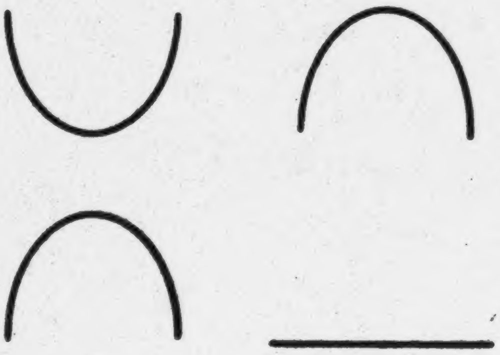

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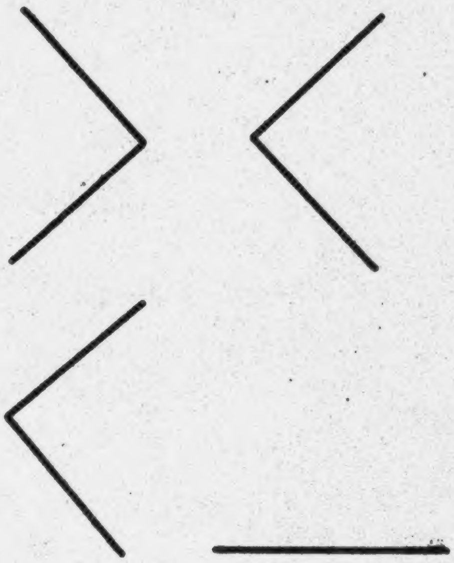

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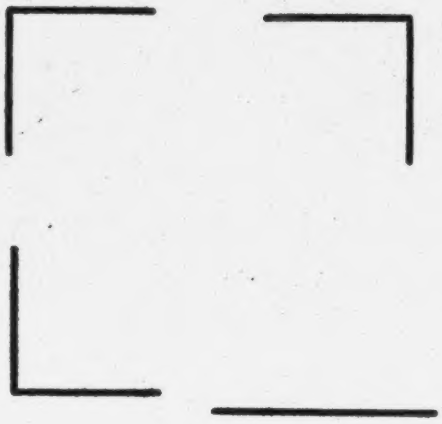

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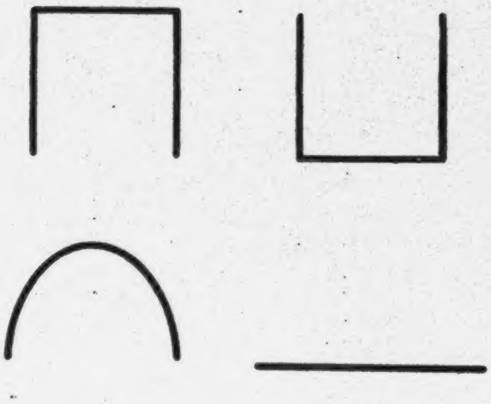

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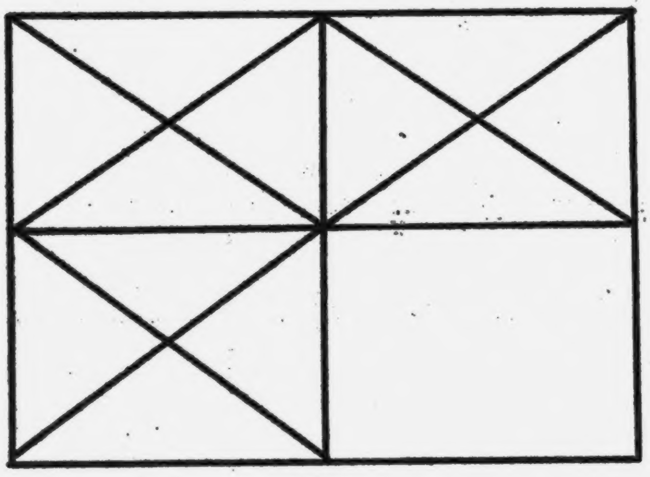

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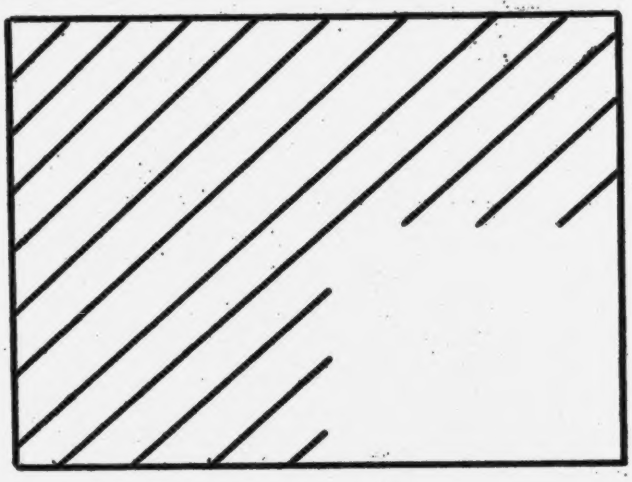

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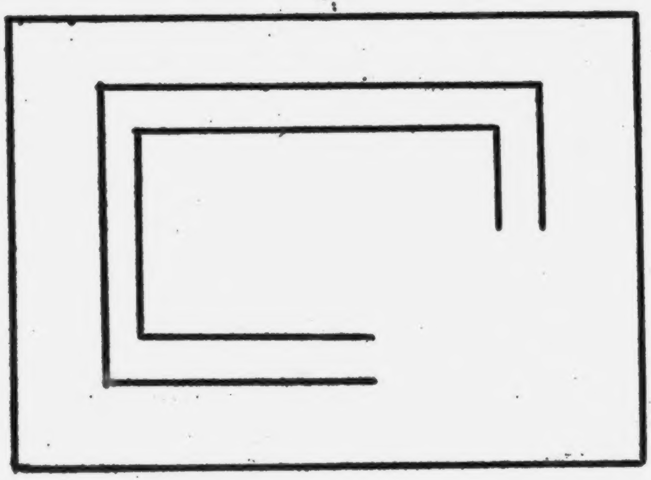

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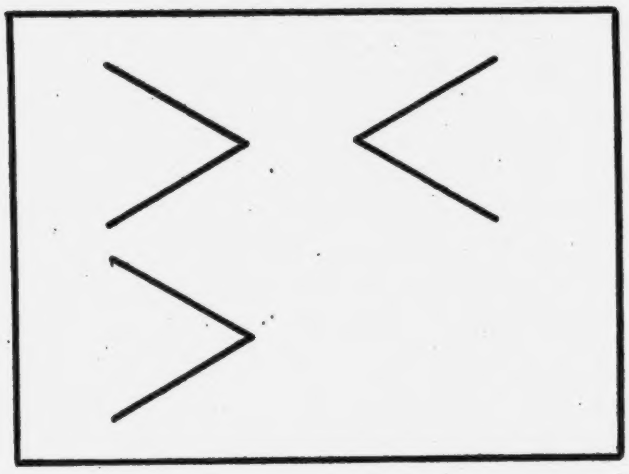

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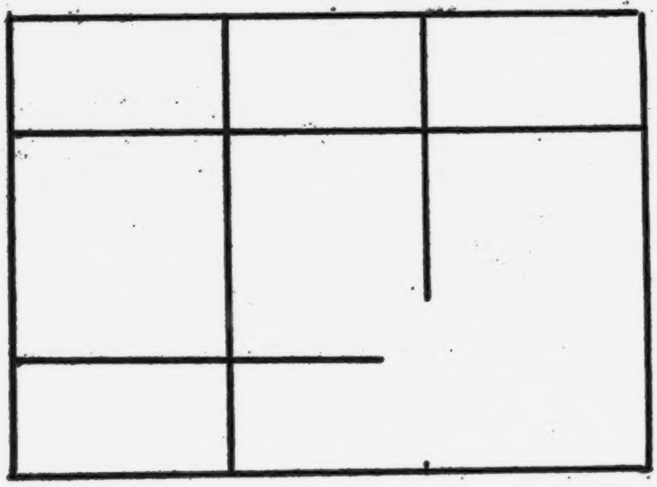

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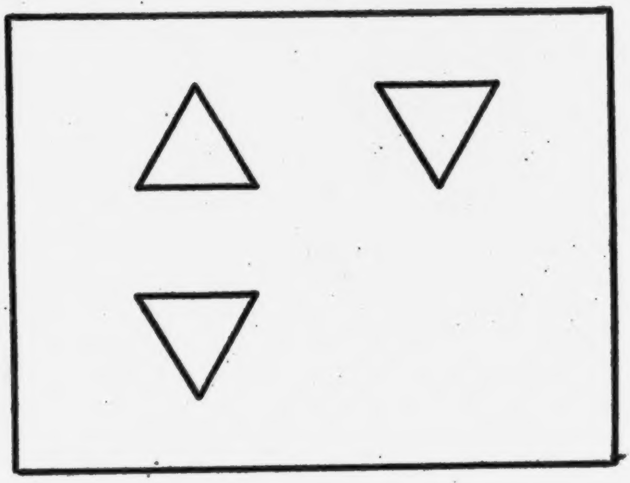


11. High-low,
12. Run-walk,
13. Loud-soft,
14. In-out,
15. Fast-slow,
16. Rough-smooth,
17. Throw-catch,
18. Short-long,
19. Many-few,
20. Round-square.

Exercise 20: Embedded Figures

Materials. The materials for this exercise consisted of seven four-inch square plactic overlays on which each figure had been reproduced with black acetate ink. The figures that were used are shown in Figure 10.

Procedure. After a brief review of the concepts of part and whole by using the materials from exercise 5, the subjects were divided into groups of two and were given the first set of overlays (designs 1-4). Subjects were told that they were to take turns hiding and finding figures. The experimenter then demonstrated the procedure for each group by using the first set of overlays. One member of each group was instructed to close his eyes while the experimenter and the other member hid the small square within the set of overlays. The subject who was to find the figure was then told to open his eyes and to find it. The procedure was then repeated with the first subject closing his eyes and the second subject hiding the figure. In each case the subjects were reminded that they could find the figures if they observed how all the parts went together to make the whole figure.

Tenth Day

Exercise 21: Figure-Ground Reversal

Materials. This exercise employed four designs reproduced in duplicate on 8½x11 inch paper. The first design was a U-shaped figure,

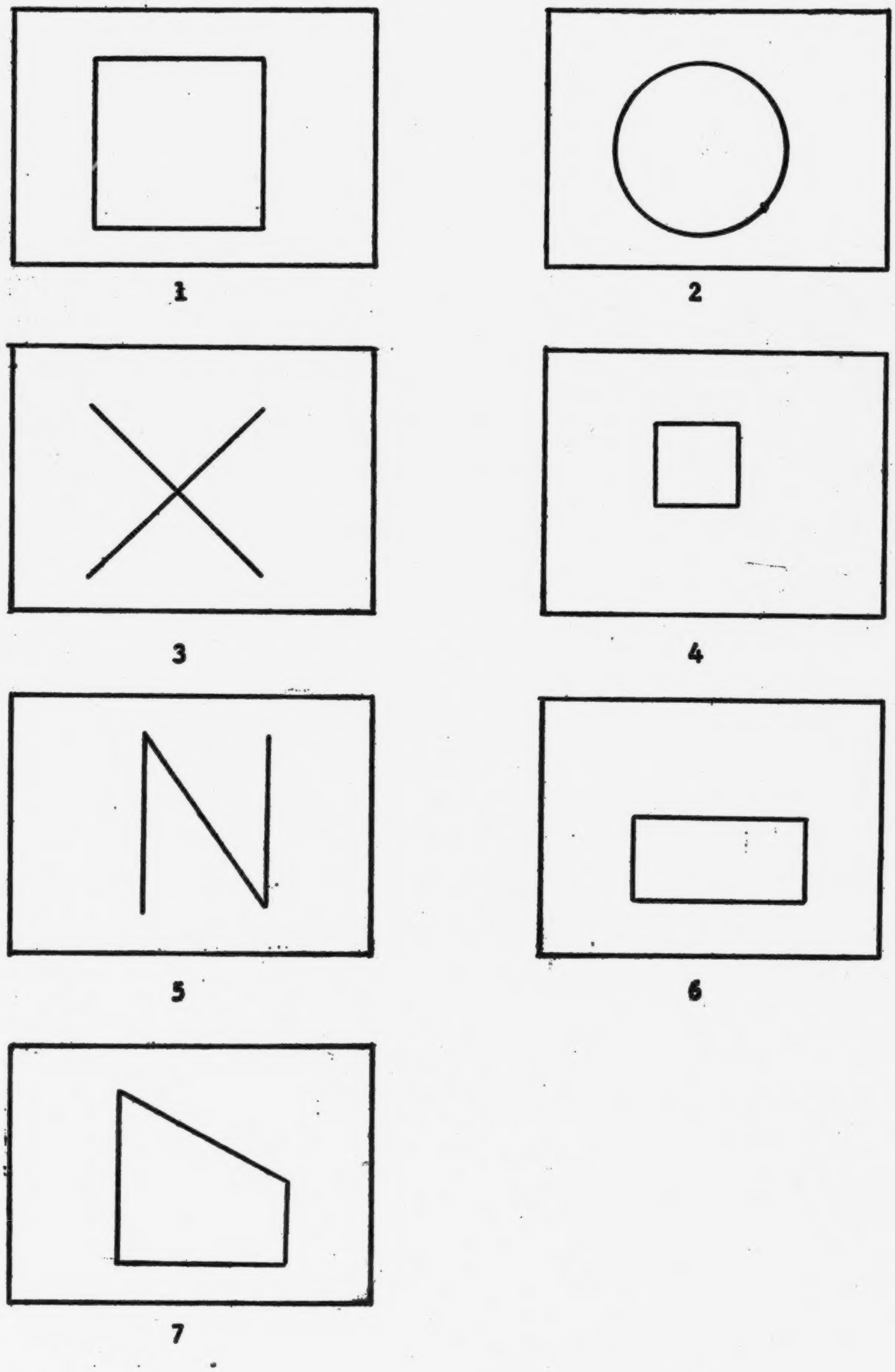


Figure 10. Exercise 20: Embedded figures

one-half inch in width, formed from three sides of a four-inch square. The second design was a symmetrical cross, one-half inch in width, circumscribed by a four-inch square. The third design was composed of two half-circles with 1½ inch radii circumscribed by a four-inch square.

Procedure. After a brief review period in which the materials from exercise 14 were used, the subjects were divided into groups of two each. The groups were instructed to take turns coloring and reversing designs. One member of each group colored the first design with two colors of his choice, and the second member reversed the first design with the same two colors.

Exercise 22: Class Naming

Procedure. The subjects were asked to name as many letters and articles of clothing as possible in three minutes. The procedure was the same as that used for exercises 6 and 10.

Eleventh Day

Exercise 23: Card Sorting

Materials. The materials for this exercise were five sets of 3x4 inch cards, four cards per set, on which various pictures of objects were reporduced. The pictures used were the following:

1. Cow, barn, dog, doghouse;
2. Two blocks, two balls, three blocks, three balls;
3. Chicken, chick, cat, kitten;
4. One cent, one sucker, two cents, two suckers;
5. Saw, scissors, girl cutting, boy sawing.

__Procedure__: The subjects were given the first set of cards and were instructed to spread them over their desks. The experimenter then held up two cards and asked how they were alike and how they were different. This procedure was followed for all appropriate combinations of the four cards. In cases where the principle of sorting implied a relationship rather than a similarity, the experimenter asked which two cards "went together." The subjects were then instructed to put two cards which were alike in one pile on their desks and the other two which were alike in another pile. After each subject had successfully sorted according to one principle, the group was instructed to sort according to a second principle that was different from the first sorting. The concepts of similarity and the principles of sorting were reviewed by the experimenter after the completion of each item.

Exercise 24: Tell About This

__Materials__. The materials for this exercise were a hammer, a ruler, and a corn cob pipe.

__Procedure__. The procedure was the same as that for exercise 12.

Twelfth Day

Exercise 25: Object Sorting

__Materials__. The materials were five sets of geometrical figures with four figures per set which had been cut from colored cardboard sheets. The figures and the principles of sorting were the following:

1. Two circles and two half circles - red and blue
   (shape and color);

2. Two octagons and two heptagons - yellow and blue (shape and color);
3. Four pentagons - all green (size and shape);
4. Two squares and two hexagons - all red (shape and symbol);
5. Two triangles and two quadrangles - four colors (shape and size).

Procedure. The same as that for exercise 23.

Exercise 26: Multiple-Choice Embedded Figures

Materials. The materials consisted of 12 problems reproduced on two 8½x11 inch sheets of paper. Each problem was composed of a single figure presented at the left of a row of four more complex figures. The simpler figure was embedded in only one of the four pictures presented on the right (see Figure 11).

Procedure. After a brief period of review by using the materials from exercise 20, the subjects were given the first page of problems and were instructed to mark the figure on the right that contained the figure at the extreme left. The first two rows of problems were used as examples.

Thirteenth Day

Exercise 27: Coding

Materials. The materials for this exercise consisted of a 5x6 matrix of circles, triangles and squares reproduced in random order on two 8½x11 inch sheets of paper.

Procedure. The subjects were instructed to put the number one inside all the squares, the number two inside the circles, and the number

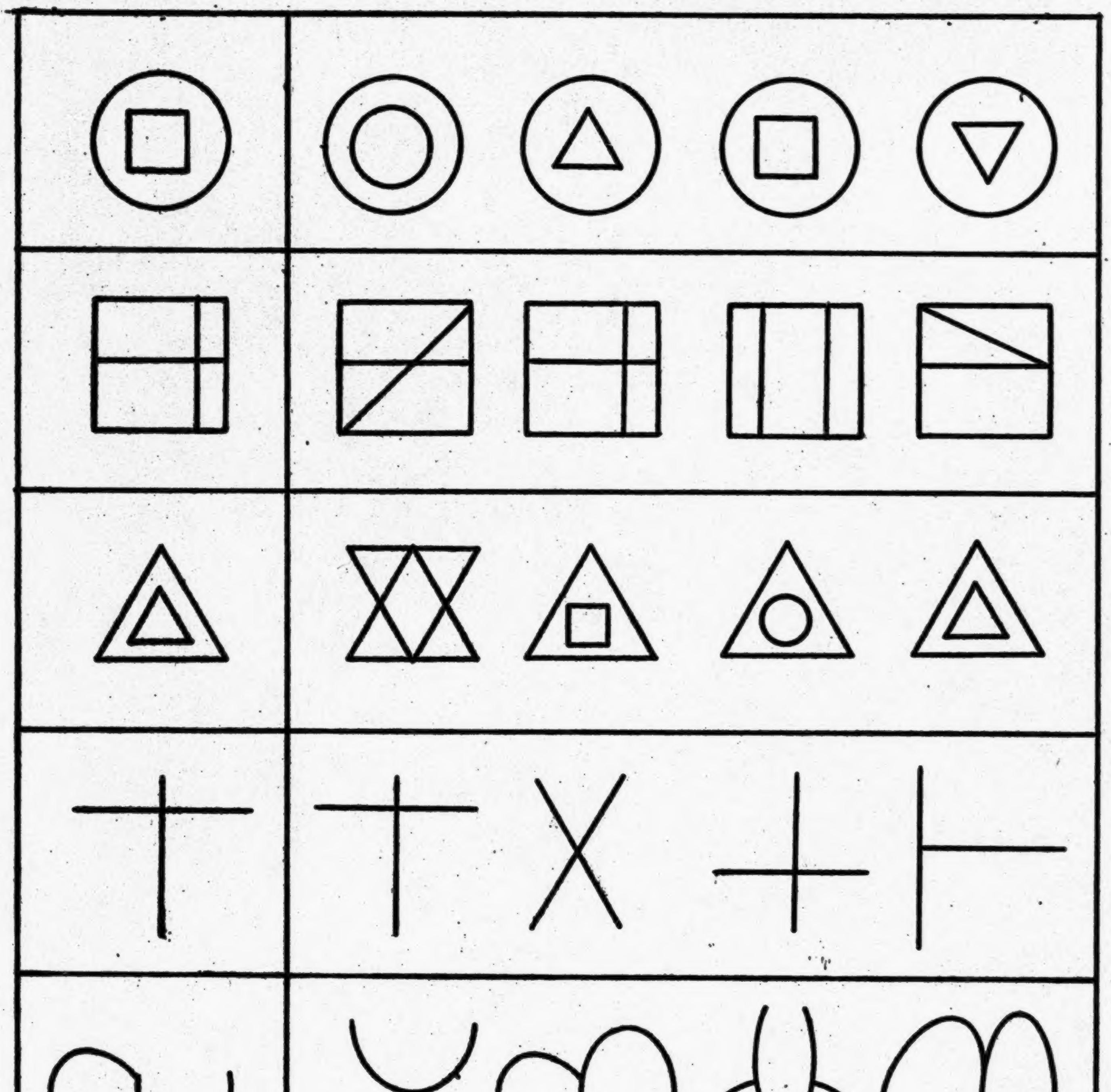
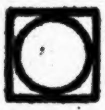
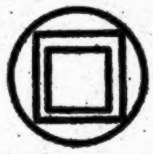
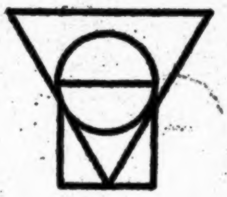
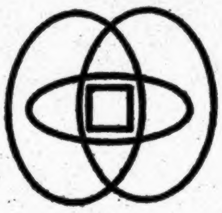
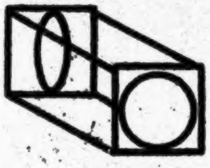
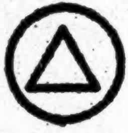
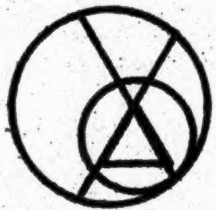
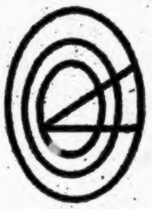
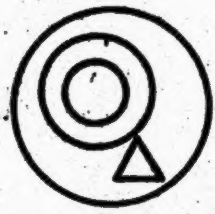
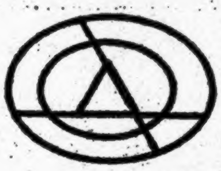
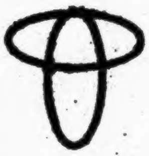
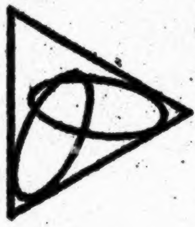
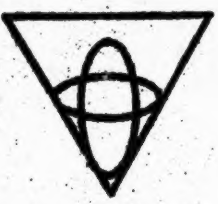
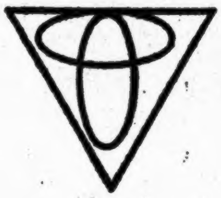
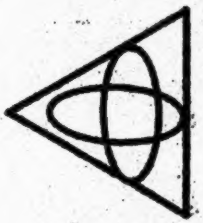
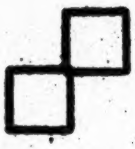
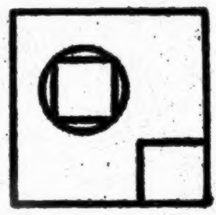
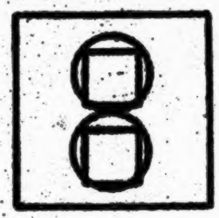
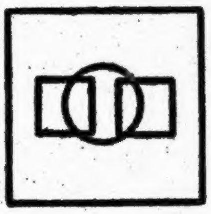
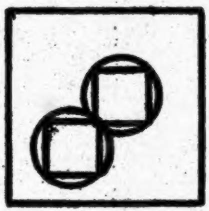
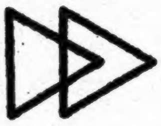
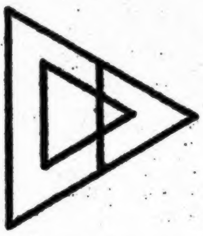
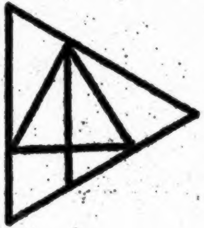
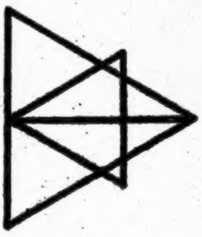
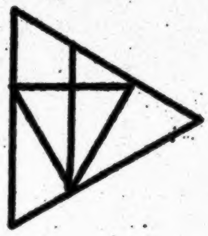
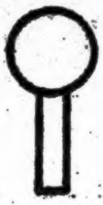
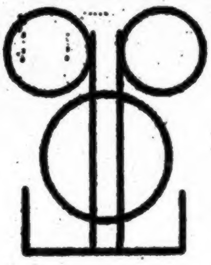
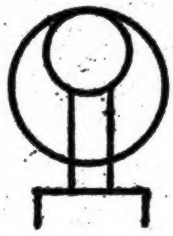
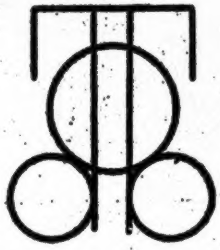
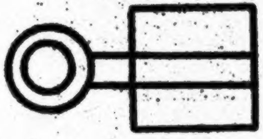


Figure 11: Exercise 26: Multiple-choice embedded figures

three inside the triangles. This sequence was reversed for the second page of figures. In general the procedure was the same as that for exercise 15.

Exercise 28: Figure-Ground Reversal

Materials. The materials were two sheets of black and white construction paper and eight figures cut from black and white construction paper. The figures were a square, an octagon, a diamond, two small triangles, and the profiles of a face, a tree, and a guitar.

Procedure. The subjects were divided into groups of two and were each given a set of figures and paper. The concepts of figure, ground and figure-ground reversal were reviewed with the materials from exercise 1. The subjects were instructed to take turns pasting figures on backgrounds and then reversing the first configurations. The square was used as an example.

Fourteenth Day

Exercise 29: Classification

Materials. For this exercise, 14 rows of drawings reproduced on two 8½x11 inch sheets of paper were employed. Each row contained four pictures of objects which could be classified into groups of two according to two principles.

The drawings were the following:

1. Chicken, milk, cow, egg;
2. Tree, plant, leaf, flower;
3. Ink, lead, pencil, pen;
4. Dog, collar, horse, saddle;
5. Boy blowing, drum, boy beating with sticks, horn;
6. Stove, word "hot," refrigerator, word "cold;"

7. Nickel, number 1, penny, number 5;
8. Arrow pointing left, word "left," arrow pointing right, word "right;"
9. Word "heavy," word "light," log, leaf;
10. Sailboat, propeller, sail, airplane;
11. Circle, half circle, number 1, number ½;
12. Word "stop," red light, green light, word "go;"
13. Two ellipses, one line, one ellipse, two lines;
14. Two circles - one with straight line and one with curved line - two squares with same context elements.

Procedure. The subjects were given two copies of the first page and were instructed to mark an "X" through the two pictures that were alike in some way and to circle the other two which were alike. After all subjects had successfully completed the first row of the first page, they were asked to shift their classification by marking the same pictures on the second page according to a second principle of classification. The first two rows were used as examples. In each case the experimenter called out the names of all four objects, one row at a time. Corrective feedback was given after the completion of each row.

Exercise 30: Rhymes

Procedure. The procedure was the same as that in exercise 18. The stimulus words used were "book," "say," and "fun."

Fifteenth Day

Exercise 31: Card Sorting

Materials. The materials for this exercise were five sets of 3x4 inch cards, with four cards per set, on which the pictures of various objects were reproduced. The pictures employed were the following:

1. Cap, gloves, hand, head;
2. Light bulb, candle, candle holder, lamp;

3. Sailboat, car, motor boat, bicycle;
4. Skirt, pants, boy, girl;
5. Three girls, three boys, one girl, one boy.

Procedure. The procedure was the same as that for exercise 23.

Exercise 32: Reversible Figures

Materials. The materials were three reversible figures drawn on 10x12 inch white stimulus cards. The first figure was composed of a coffee pot which when reversed appeared as a face. The second figure was composed of two faces formed by a curved line drawn through the center of a six-inch square. The right side was black and the left, white. The third figure was the Rubin-Vase-Profile drawn in a six-inch square with the vase colored white (see Figure 12).

Procedure. The experimenter held up the first card and asked all subjects to tell what the picture looked like to them. After eliciting responses to both the face and the coffee pot, the experimenter explained that they could see both figures at the same time by switching the figure-ground relationship. Prompting was utilized liberally throughout this exercise. After all subjects were able to respond to both parts of the figure, the experimenter proceeded to the next figure and used the same procedure.

Sixteenth Day

Exercise 33: Embedded Figures

Materials. The materials for this exercise consisted of 12 four-inch square plastic overlays on which each figure had been reproduced with black acetate ink. The designs that were used are shown in Figure 13.

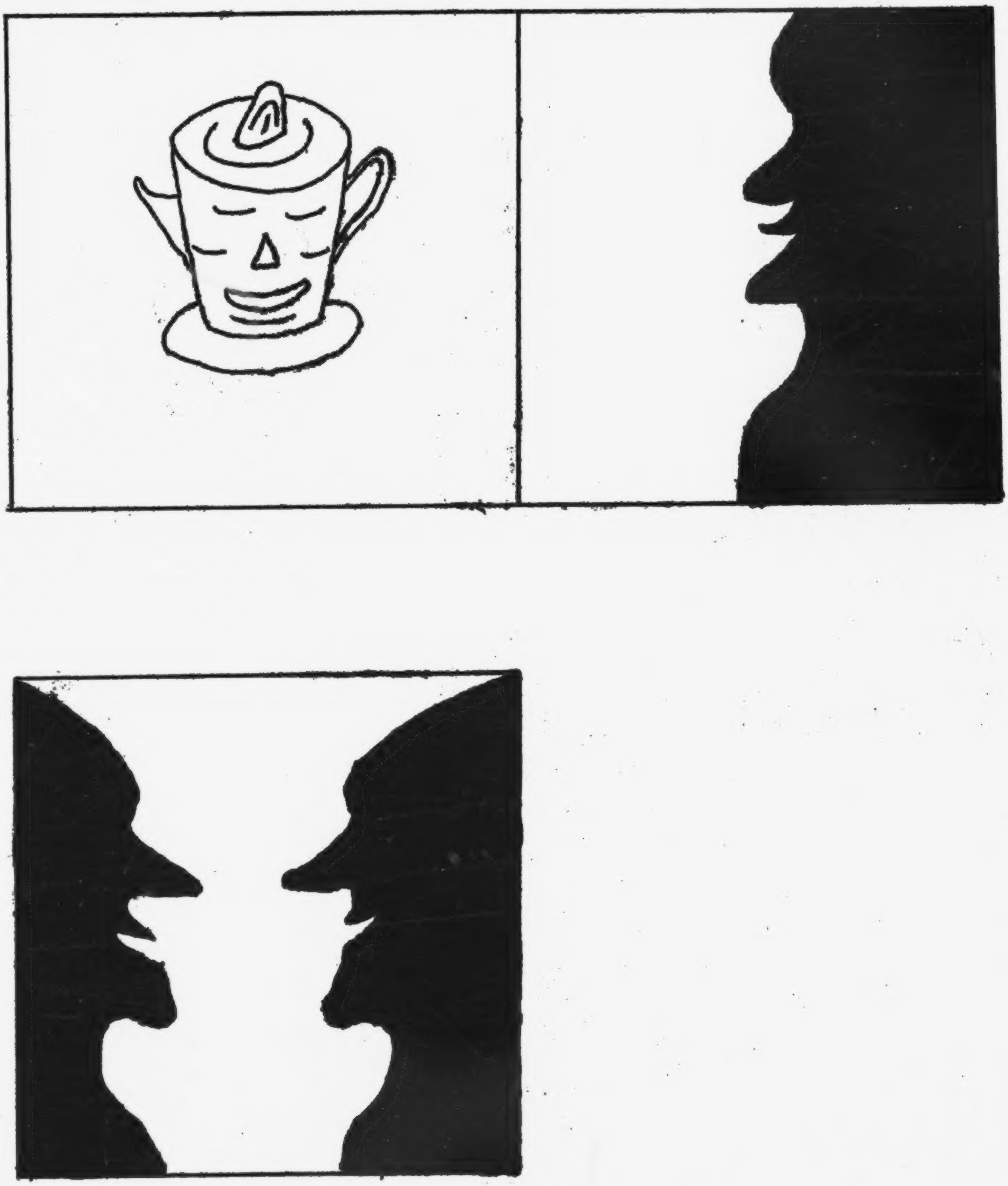


Figure 12. Exercise 32: Reversible figures

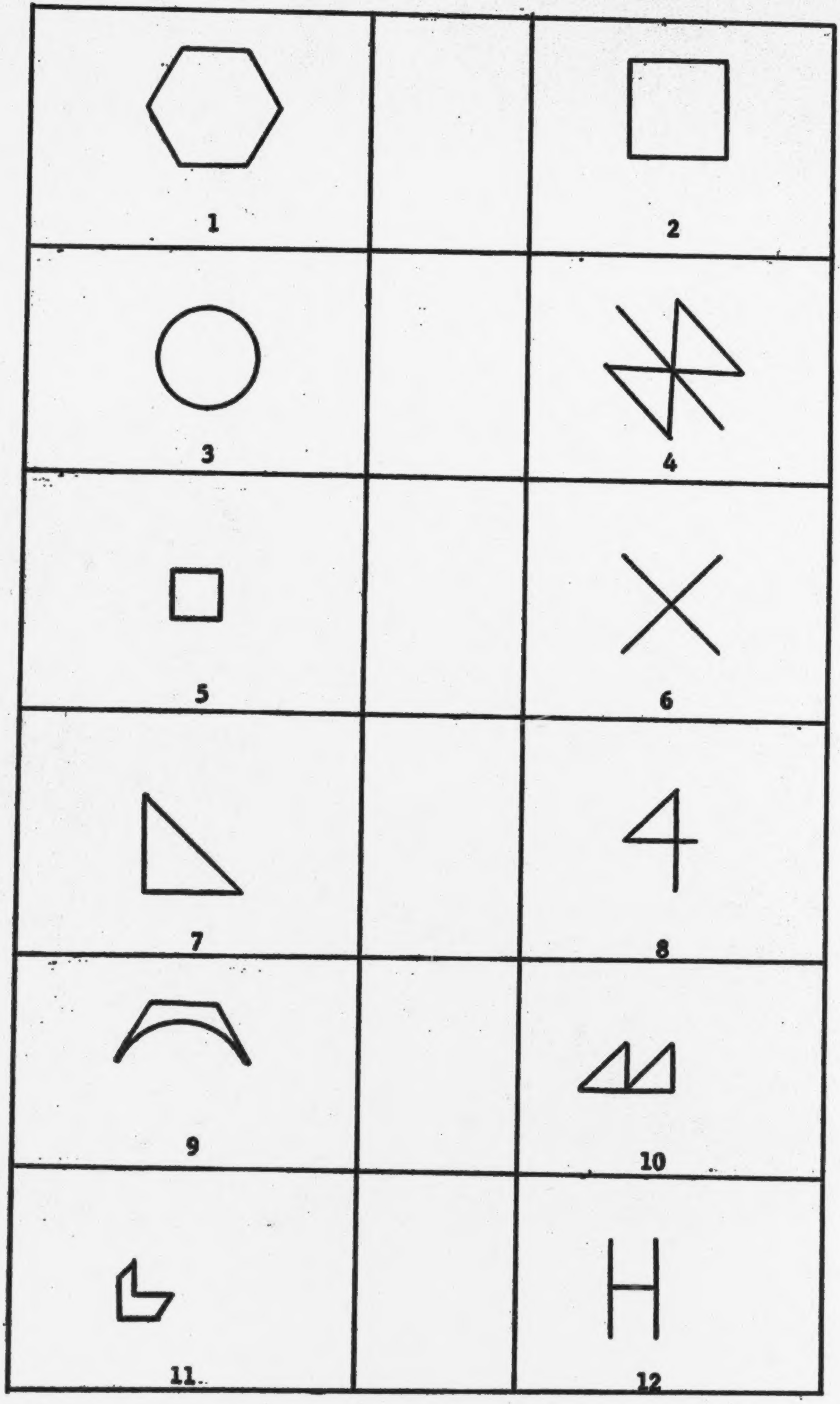

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Figure 13. Exercise 33: Embedded figures

Procedure. The procedure was the same as that for exercise 20. Figures 1-4 formed the primary configuration in which figures 5-12 were to be hidden (see Figure 13).

Exercise 34: Class Naming

Procedure. The procedure was essentially the same as that for exercises 6 and 10. The first class of concepts used was different foods, and the second was anything one could ride.

Seventeenth Day

Exercise 35: Classification

Materials. The materials for this exercise were arranged in the same manner as those for exercise 29. The pictures used were the following:

1. Ruler, crayon, circle, rectangle;
2. Box, circle, glass, square;
3. Grapes, yellow triangle, blue ellipse, banana;
4. Letter "A," letter "C," triangle, ellipse;
5. Moon, sun, light ellipse, dark ellipse;
6. Word "hit," glove, ball bat, word "catch;"
7. Number four, letter "A," letter "B," number eight;
8. Baseball diamond, football field, baseball, football;
9. Square, circle, rectangle, ellipse;
10. Cross with straight lines, curved line, straight line, cross with curved lines;
11. Letter "F," letter "S," curved line, straight line;
12. Two rectangles - one up, one down - and two triangles - one pointed up and one pointed down;
13. Four ellipses - two thick and two thin - two with triangles and two without triangles;
14. Square, cube, circle, cylinder;
15. Cone, circle with triangle, triangle, circle;
16. Curved line, straight line, two straight lines, two curved lines.

Procedure. Same as that for exercise 29.

Exercise 36: Tell About This

Procedure. The procedure was the same as that for exercise 12. A red plate, a coat hanger, and an 8x8 inch piece of white cardboard were used as stimulus objects.

Eighteenth Day

Exercise 37: Object Sorting

Materials. The materials for this exercise consisted of 16 geometrical forms that were cut from four-inch square colored cardboard. The colors were red, yellow, blue and green. Four objects within each color group were varied according to shape. The shapes were triangular, quadrangular, pentagonal and semi-spherical. One basic shape was represented within each color group. In addition, a two-inch colored square was pasted on each object, and one of four letters and numbers was drawn on each object with black ink. The letters were "A," "B," "C," and "D;" and the numbers were "1," "2," "3," and "4." Thus, five principles of sorting were present: color of the object, shape, color of the square, letter group, and number group.

Procedure. The experimenter sat at a table near the center of the room, and the subjects were asked either to sit or stand around the table. Care was taken to insure that all subjects could see the materials. Although the procedure for this exercise was essentially the same as that for exercises 23 and 25, only three sortings using the same 16 objects were made. In the first sorting the experimenter spread the yellow square, yellow triangle, green quadrangle and green triangle across the table and asked the subjects to tell how they could put two objects that were alike in one pile and the other two objects that were alike in another pile. After the first sorting was accomplished, the experimenter elicited a second sorting as in exercises 23 and 25. After reviewing the concepts involved in the first sorting, the experimenter spread five additional objects across the desk, thus adding these objects to those already present. The second set of objects was the following: the yellow, green and blue semi-ellipses; the blue quadrangle; and the blue triangle. The procedure for the second sorting was the same as that for the first except that three principles of sorting were elicited and illustrated. After the second sorting, the experimenter added the rest of the objects and proceeded as before, except that five principles were illustrated by the third sorting.

Exercise 38: Coding

Materials. The materials were two 5x6 matrices composed of squares which were reproduced on two 8½x11 inch sheets of paper. On the first page the letters "A," "B," or "C" appeared at the top of the squares; and on the second page the numbers "1," "2," or "3" appeared at the top of the squares.

Procedure. The procedure was the same as that for exercises 15 and 27. On the first page the subjects were instructed to code the numbers "1," "2," and "3" for the letters "A," "B," and "C," respectively. On the second page the subjects were instructed to code the letters "C," "B," and "A" for the numbers "1," "2," and "3," respectively.

Nineteenth Day

Exercise 39: Rhymes

Procedure. Same as that for exercises 18 and 20. The stimulus words were "go," "three," and "bear."

Exercise 40: Multiple-Choice Reversible Figures

Materials. The materials for this exercise were 15 rows of multiple-choice problems presented on two 8½x11 inch sheets of paper. Each row contained the stimulus figure at the extreme left and four figures on the right, one of which was the reverse of the stimulus figure (see Figure 14).

Procedure. The subjects were given the first page and were asked to mark the figure on the right that was the reverse of the figure at the extreme left. The first two rows were used as examples. Corrective feedback was given immediately after each problem.

Twentieth Day

Exercise 41: Classification

Materials. The materials were 16 rows of problems presented in the same manner as those in exercises 29 and 35. The pictures used were the following:

1. Fish, airplane, boat, bird;
2. The words "big" and "little," a large square, and a small square;
3. The words "first" and "last," the letters "A" and "Z;"
4. The numbers "2" and "4," two triangles, four triangles;
5. The words "up" and "down," arrow pointing up, arrow pointing down;
6. The words "walk" and "run," the letters "R" and "W;"
7. Light bulb, electric wires, fire, candle;

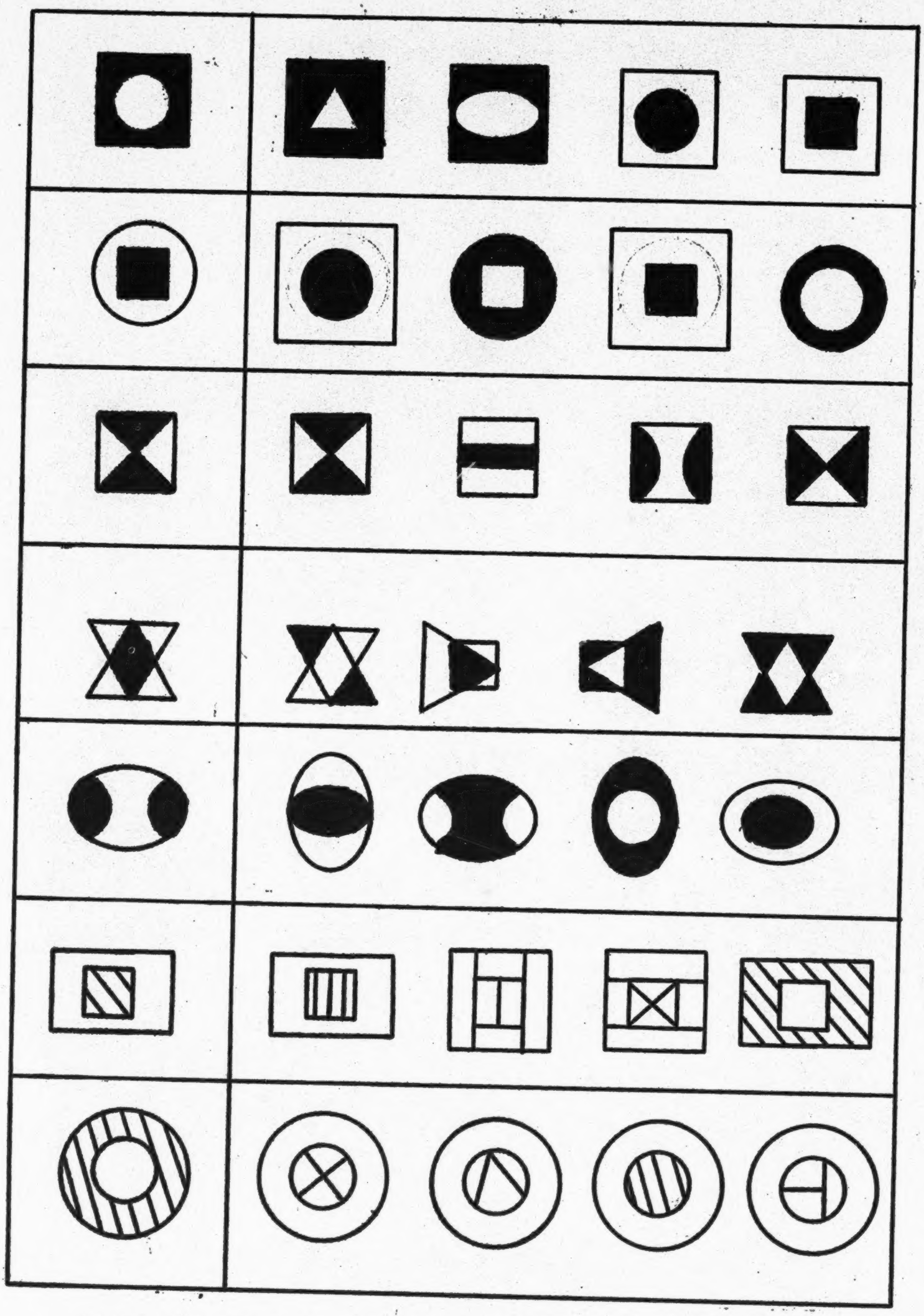
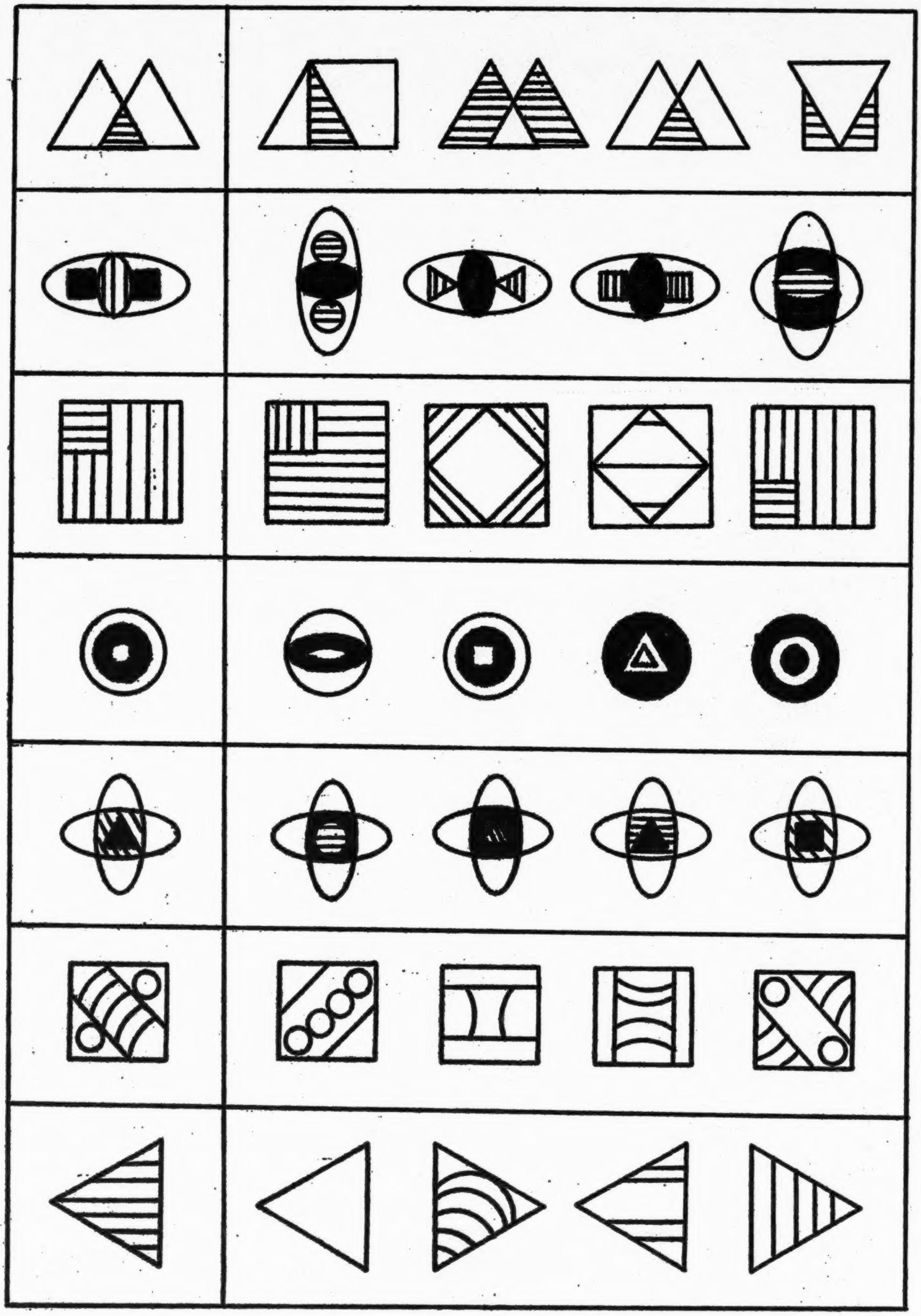


Figure 14. Exercise 40: Multiple-choice reversible figures



8. Tent with rain, circle, triangle, umbrella with rain;
9. One large ellipse, two large ellipses, one small ellipse, two small ellipses;
10. The addition of one and one, and one and two, expressed as the addition of numbers and as triangles;
11. Tall rectangle, short rectangle, short triangle, tall triangle;
12. Letters "A" and "B," the numbers "1" and "2," the number "3," the letter "C;"
13. The words "fast" and "slow," rabbit, turtle;
14. The words "in" and "out," cylinders with arrows pointing in and out;
15. The words "large" and "small," rooster, chick;
16. Lock, door, door handle, key.

Procedure. Same as that for exercises 29 and 35.

Exercise 42: Multiple-Choice Embedded Figures

Materials. The materials were 12 rows of problems presented in the same manner as those in exercise 26. The designs that were used are shown in Figure 15.

Procedure. Same as that for exercise 26.

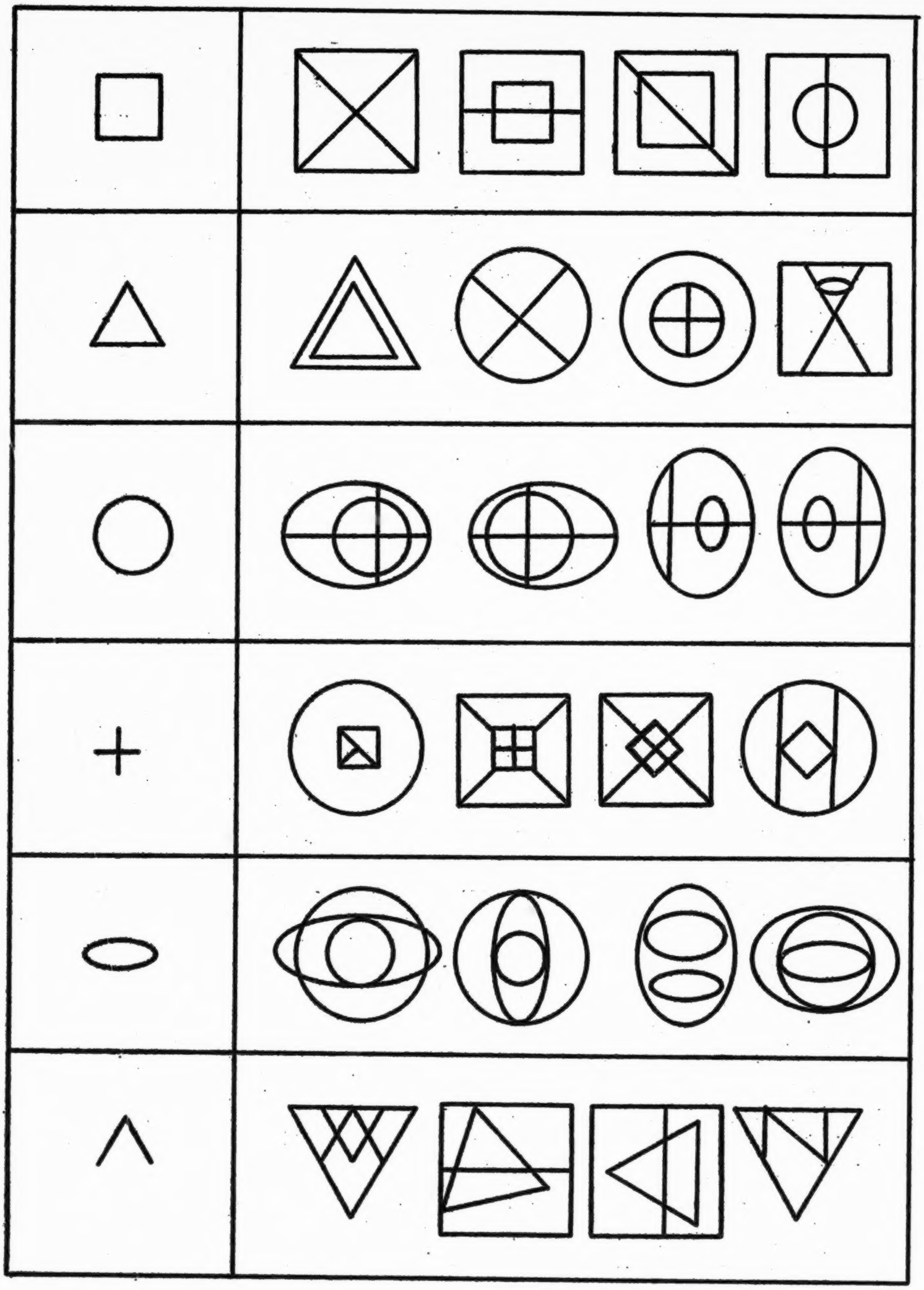
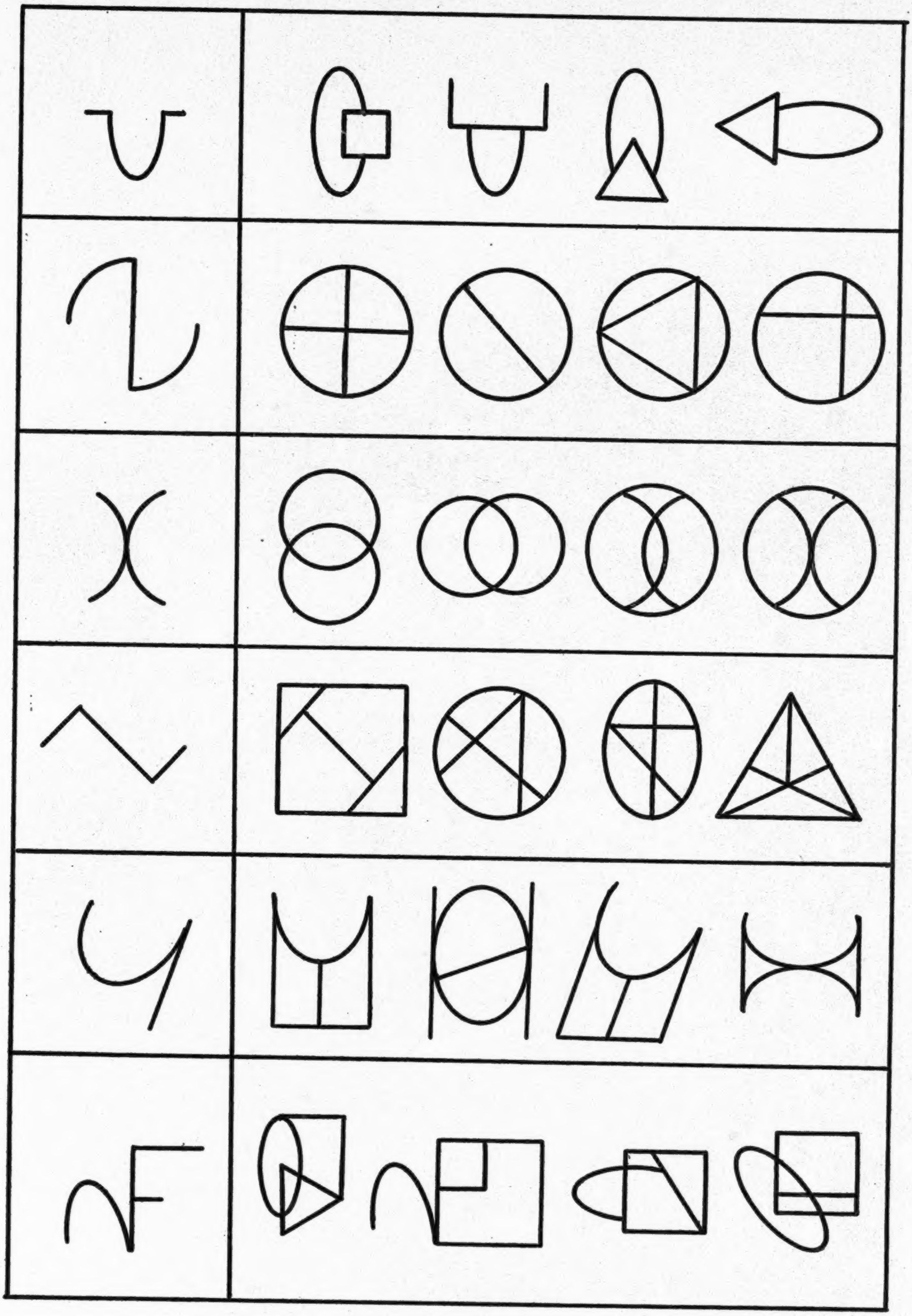


Figure 15. Exercise 42: Multiple-choice embedded figures



APPENDIX C

A DESCRIPTION OF THE PRODUCTIVITY-RESPONSIVENESS TRAINING PROGRAM

NORTH CAROLINA STATE UNIVERSITY

COGNITIVE TRAINING PROGRAM

PRODUCTIVITY-RESPONSIVENESS

TEACHERS' MANUAL

NORTH CAROLINA STATE UNIVERSITY

COGNITIVE TRAINING PROGRAM

PRODUCTIVITY-RESPONSIVENESS

The purpose of this cognitive training program is to investigate the possibility of increasing the productivity of children. It is important that children use the abilities they have to the maximum. This program provides experiences which may be helpful in training children to become more productive in three aspects of their cognitive behavior:

first, in verbal fluency by responding to ideas
second, in following instructions
third, in manipulative activities.

Speed in productivity will be emphasized in all of these activities. Materials will be presented in sequences of increasing difficulty.

Productivity and responsiveness are so interrelated that the two should be thought of together. It appears that the more wholehearted and complete the children's responses are, the more nearly they reach their maximum productivity. Therefore an important part of this training program is the responsive classroom climate established by the teacher. An atmosphere of warmth and encouragement is the beginning of setting the stage for productivity. In this training program the children should be made to feel as comfortable as possible so that they will feel free to respond, to take a chance.

The teacher should go a step further and give positive verbal reinforcement to each child's efforts. This positive reinforcement on the part of the teacher is as important to this training program as the materials themselves. Negative comments should be avoided since they might reduce children's responsiveness. Participation by all children in all activities should be encouraged by the teachers' attitude of acceptance and enthusiasm for the efforts made.

The materials used are not presented for the learning of subject matter. They are used as simple tools to increase and encourage the process and speed of their use. The materials themselves are simple and those with which children are familiar. This program is an attempt to train for faster and more effective use of children's abilities in meeting their daily tasks.

NORTH CAROLINA STATE UNIVERSITY

COGNITIVE TRAINING PROGRAM

PRODUCTIVITY-RESPONSIVENESS

First Day

Exercise 1: Verbal Response

Procedure. The purpose of this task is to see how quickly the children can respond by naming their classmates. The teacher calls the name of a child, the child quickly responds by calling the name of another child, and so on, until all names of the children have been called. After this is done once, the teacher talks about the meaning of the words "fast", "slow", "quickly". Explain the importance and fun of saying things quickly.

This naming activity should be repeated three times, trying to increase the speed of response each time. To vary the procedure, the teacher can walk around children's desks, tapping each desk in sequence. The children should respond with a name when desk is tapped. The teacher should comment favorably on those children who respond quickly.

Exercise 2: Following Directions

Materials. First three pages in children's workbook and crayons.

Procedure. The purpose of this activity is to train children to listen attentively and follow directions. The teacher talks about the importance of doing things quickly as well as answering quickly. To do things quickly, children must listen carefully to instructions. In this activity it is important to listen carefully to "the rules of the game" because then the game can be finished more quickly! The fastest workers will be the winners. First page 1. Color all the circles red. Allow one minute. Recognize the children who finish first. Recognize those who have colored the most circles. Second page 2. Color all the circles blue. Allow one minute. Children should compare the two papers. Did they color more blue than they did red? Who colored the most circles? Point out that improvement is possible in increasing the number of circles colored within the minute allowed. Third page 3. Color all the circles green. Allow one minute. Children should compare this paper with the blue and the red. Did they color more green than blue or red? Who colored the most? etc. By verbal response, the teacher should show her approval of all work done, emphasizing the importance of each child improving his own working skills.

Exercise 3: Manipulation

Materials. Blank sheets of paper for each child.

Procedure. This is an exercise in finger dexterity and speed. The importance of doing things quickly is explained (so more things can be done, have more fun, etc.). Have children hold up their hands in front of them, fingers extended. Tell them to stretch their fingers, and then make a fist. Demonstrate this. Then explain and demonstrate how this exercise can be done slowly, gradually increasing speed. Demonstrate this with children several times until they are opening and closing their fingers as quickly as possible. Mention the fun of doing things quickly!

The children are then given a sheet of blank paper. Tell them that they are to tear this in as many pieces as possible, as quickly as possible. Time this exercise to one minute. Praise is given, "Look how many pieces of paper you made!", etc. They see how fast some child can go around to each desk with wastebasket to collect pieces of paper.

Tell children the fastest and best way to get all the pieces of paper off their desks and into wastebasket is to have the pieces of paper in a pile near the edge of desk so that they can be swept in wastebasket with one movement of hand and arm. See if all desks can be cleared in 2 minutes. Comment favorably on how nice it is to get things done so quickly!

Second Day

Exercise 4: Verbal Response

Procedure. The purpose of this activity is to see how many things in the room can be seen and named. The concept of speed and the importance of getting things done quickly are reviewed. This awareness activity is combined with verbal response. Explain that different things in the room should be named, but children should not be made to feel "wrong" if they forget and name an object more than once. In a general way say "Let's see if we can each name something different." Again the procedure used is to go around the room three times, each time picking up speed. Reinforce children's efforts, "_____ you're getting faster all the time." "You have the right idea." "We're all working faster now", etc.

Exercise 5: Following Directions

Materials. Pencils and blank sheets of paper for children.

Procedure. Explain that it is important to write names as quickly as possible. Children are each given one sheet of paper and a pencil. They are to write their first names as many times as possible in one minute. The five children who write their names the most times are named the champions. This exercies is repeated by the children turning the paper over and again writing their names as many times as possible in a minute. The five children who write their names the most times are named champion "name writers". Comment favorably on everyone taking part and working. "It is important to always try to do your best."

Exercise 6: Manipulation

Materials. Two sheets of paper with marked lines for each child, scissors.

Procedure. The exercise of flexing fingers (extending and making fist) is repeated. Stress concepts of slow and fast as action takes place. Say "Let's see if we can make our hands work faster today than yesterday". Emphasize the positive aspects of speed, getting things done fast. "We can get so many things done." Enthusiasm is important. "Do you think we can work faster today?"

The purpose of this exercise is to see how quickly the children 1) can get their scissors, 2) cut across each of the four lines, 3) place the five pieces of paper on their desks, 4) return their scissors to the usual storage place. The four steps of this exercise should be carefully explained. Be sure that the children can repeat what is to be done before starting. Children are given sheets of paper on which four lines have been drawn. Each child should have a pair of scissors. Allow 3 minutes for the four steps. "Let's see how many can finish before I say 'stop'."

Give children a second sheet with four marked lines. Same instructions. Allow 2½ minutes. Say, "Let's see how many you can finish before I say 'stop' this time." Comment favorably on those who worked quickly, again emphasizing the value of getting things done as fast as possible, "Just like you were out working on a real job".

See if all desks can be cleared of paper in 1½ minutes. Comment favorably on children's work.

Third Day

Exercise 7: Verbal Response

Procedure. The concept of speed is reviewed. The awareness task of naming objects in the room is now combined with verbal associations. Objects are named and descriptive words are added. For example, as the children take turns naming objects in the room, a verbal characteristic is added: desk - wood, chalk - white, book - paper, etc. Not only is speed a stressed factor, but also the different kinds of characteristics are important. Children are reminded to consider shape, color, size and materials. This activity is done twice with each child having two turns. All children are encouraged to respond, with no penalties for children who find difficulty in thinking of characteristics. Help may be given by saying "How about the color?" or "What is it made out of?" "Think about the shape", etc. Positive verbal reinforcement is given to those who respond quickly. "You have good ideas", "You are thinking well", etc.

Exercise 8: Following Directions

Materials. 3 pages in children's workbook, one crayon for each child.

Procedure. There are three similar tasks to be followed in sequence. The children are reminded that it is important to work quickly. Before beginning this activity the teacher should be sure that the children know the names of the three shapes, circles, squares and triangles. These chould be put on the chalkboards and named.

The three worksheets to be used are alike, covered with rows of assorted circles, squares and triangles. The children are given one sheet at a time. One minute working time should be allowed for each sheet.

First, the children are given one worksheet each and instructed to cross out all circles as quickly as possible. One straight line through each circle may be considered "crossing out".

Second, the children are given another sheet of paper with the same circles, squares and triangles, and instructed to cross out all squares as quickly as possible. The teacher should say, "See if you can cross out more squares than you did circles."

Third, the children are given one worksheet each and instructed to cross out all triangles as quickly as possible. The teacher should say, "See if you can cross out more triangles than you did squares".

Children should then compare their three papers counting,

first, how many circles are crossed out,

second, how many squares are crossed out,

third, how many triangles are crossed out.

The teacher should point out that the children who have crossed out more squares than circles and more triangles than squares are learning to work faster. Recognition should be given to those children who are "fast workers".

Exercise 9: Manipulation

Materials. Blank sheets of paper for each child.

Procedure. Begin with a relaxing exercise, reviewing speed in physical activity. Have children stand. Riase arms straight up over head, close fists. Next point each index finger straight up. While arms are over head, wiggle index finger slowly, gradually increasing speed until fingers are moving as fast as possible.

The object of this manipulative exercise is to fold a sheet of paper as many times as possible, as quickly as possible. This folding task is demonstrated by the teacher with a sheet of paper 8½" x 11". Five foldings will produce a small rectangular shape. Open sheet and demonstrate again so that the children understand the task. Then each child is given a sheet of paper and told to begin folding. Recognition is given the first few children to finish. "_____ you used your finger to work quickly", "You're a fast worker", etc. Have all children open their folded sheets and notice the blocks they have made. Have them fold again as quickly as possible. These papers can be used to create unusual patterns of color by crayoning each block differently.

Fourth Day

Exercise 10: Verbal Response

Procedure. This is an ideational task in which the children are asked to discuss how many different kinds of things are balls or shaped like balls. Those things emphasized are the various types of balls used in different kinds of sports and also those things with the shape of a ball, e.g., a BB shot, buttons, life savers, tires and wheels.

After the children get the idea of the many ball or round shape objects that are part of our daily lives, turns can be then taken around the room naming things of this shape.

A second turn should be taken to see if children can think and name round objects more quicly than the first time.

Exercise 11: Following Directions

Materials. Two blank sheets of paper and a pencil for each child.

Procedure. There are two parts to this days "following directions" activities.

Part 1. A familiar song is introduced. Old MacDonald Had a Farm. The song is sung very slowly at first. Then the teachers should talk about the difference between singing slowly and fast. The song should be sung again, faster with spirit. Next the song should be sung slowly, children clapping as well as singing. The fourth time the song is sung it should be sung as fast as possible with clapping of hands.

Part 2. Children are given a blank sheet of paper and a pencil. They are told that they are to make a pair of letters as quickly as possible. These letters are to be AB. The pair AB should be written on the chalkboard before the task is started. When the directions are understood, the children are told that they are to make as many pairs of AB's as possible in one minute. This task is repeated a second time. Chidren are to check their papers to see if they made more pairs of AB the second time. The five who made the most AB are declared the champions. The teacher should remind the children that they can learn to work faster.

Exercise 12: Manipulation

Materials. 1 book for each child, 2 paper bookmarks for each child.

Procedure. This training exercise involves the handling and use of books. The purpose is to see how quickly children can take books from their desks, turn to given pages and place paper markers at those pages. Any books with which the children are familiar may be used. Explain and demonstrate to children how the book markers are to be put in between the pages at the top of the book when the page numbers are called.

Emphasize the importance of speed in taking books from desk (with of course care of the book itself), finding the correct page and putting the marker in. Say "Let's see who will be the first to find the pages and put the markers in", etc.

Each child should be given two markers of different colors. When class is ready, say "Let's get out our books and find page 10. When you find the right page, put your marker at that page and close your book." The numbers 10 and 15 may be written on the chalkboard. When page 10 has been found and marked, use some procedure for page 15. Recognition for those working quickly should be given. "Good workers usually work quickly", etc.

Fifth Day

Exercise 13: Verbal Response

Procedure. This is an activity in naming fruits, and describing their characteristics. The teacher initiates a discussion of fruits as food, and something that is good to eat, and "good for us". Then the teacher says "Let's see how many fruits we can name". Each child should have a turn naming a fruit. If a child names a vegetable, say something like this, "I'm glad you answered, _____. This shows you're thinking. _____ is a vegetable. Tomorrow we'll have a game naming vegetables.

Be sure to give your answer then. A fruit would be a _____." Emphasize and positively reinforce the child's response. In this training program, for the purpose of increasing responsiveness, any response is right. Make the child aware of your approval in responding.

Next the fruit naming goes around for another turn each. This time emphasize speed in responding. "Let's see how fast we can name a fruit this time." There should be no verbal penalties for repeating already named fruits. Teacher may say, "Let's see if we can think of something different."

The third time around fruits are named, have children add a characteristic: orange - round or orange color, apple - red, peach - fuzzy, etc. The fourth time around, have children name fruit and characteristic as quickly as possible.

Exercise 14: Following Directions

Materials. Blank sheet of paper and pencil for each child.

Procedure. This is an exercise in writing the pair 12 with as much speed as possible. Several pairs of 12's are written on the chalkboard so that children understand that the two numbers are to be written together.

Children are given paper and pencils and instructed to write as many pairs of 12's as they can in one minute. The children who finish first are named "fast workers".

This exercise should be repeated. The other side of the paper is used. Children are asked to check to see if they have made more pairs on the second sheet than on the first. Children who have increased their speed are "champion fast workers".

Exercise 15: Manipulation

Materials. Packets of construction paper. 15 items in each. One packet for each child.

Procedure. This is an activity of sorting construction paper items by shape and color. Material in this testing exercise consists of 15 items, including different shapes (circle, square, triangle) and 5 different colors (red, blue, green, yellow and orange).

The shapes should be illustrated on the chalkboard and the fact that each is different from the other pointed out. The five different colors should be reviewed briefly.

This is a speed game that is to be played two ways. First the 15 construction paper items should be divided into the five color groups (on their desks). Recognition should be given to those finishing this first. "You're a fast worker!" "You get things done so quickly", etc.

The paper items should be jumbled together and the second part of the game is played by sorting the 15 items by shape. Children should be urged to work quickly. Recognition should be given to those who finish first. "You're a champion!" You're thinking fast", etc.

Sixth Day

Exercise 16: Verbal Response

Procedure. Review fruit naming by having each child name as many fruits as possible without stopping. Children should be encouraged to name the fruits as quickly as possible. Recognition should be given to those who can "think and name" quickly.

The same procedure as in exercise 13 is used with vegetables, with special recognition given to children who are responsive, and who improve in speed.

Exercise 17: Following Directions

Review of song "Old MacDonald Had a Farm" singing it slowly at first, then increasing speed until the song is sung as fast as possible. Clapping may accompany the singing to add to the concept of speed.

Materials. 2 identical pages from chidren's workbook, pencils.

Procedure. This is a coding exercise. A page of A's and B's are arranged in rows, alternating with blank rows. Children are instructed to write "A" or "B" in the blank squares under the matching letter. They are to do this as quickly as possible. Time should be checked until the first five children are finished. These are recognized as "fast workers".

The teacher then explains that another page is to be done in the same way. The teacher will allow the same time for working as was used for the first work sheet. The teacher should say, "Five of you finished the page in _____ minute(s). This time let's see if more than five of you can finish in the same amount of time".

If more children than the original five finish in the allotted time, special recognition should be given these children since this will be a real example of how children can increase their "production". All children who finish in the allotted time should be called "champion workers".

Exercise 18: Manipulation

Materials. Sheet of marked paper and scissors for each child.

Procedure. The pupose of this activity is using scissors in cutting crossed and rounded lines.

The children are reminded that it is important to work as quickly as possible. Say "I wonder who will be our faster workers today?"

"Are you all ready to work quickly?" "It's fun to do things fast - it's like a game!", etc. The children are shown a sample of the page they are to cut. Attention is called to the lines, their different directions and shapes.

Children get out their scissors and cut along the lines. The various pieces of paper resulting from the cutting are spread out on their desks. The children finishing first are recognized as the "champion workers". See how quickly scissors can be put away and the paper removed from desks into wastebasket (as in Exercise 6).

Seventh Day

Exercise 19: Verbal Response

Procedure. First the naming of vegetables is reviewed (see Exercises 13 and 16). The additional tasks are to add a characteristic when naming vegetables. When taking the third turn around, each child is to name as many vegetables as possible without stopping. Positive verbal reinforcement is given for all responses, with special recognition to those children who respond quickly.

Exercise 20: Following Directions

Materials. Page from children's workbook of clown holding balloons.

Procedure. This is an embedded figure task, the purpose of which is to see how many circles the children can find in picture. This should be done as quickly as possible. Later this sheet may be used for crayoning.

Exercise 21: Manipulation

Materials. ~~One~~ Three pieces of tag board, two elastic bands for each child.

Procedure. The purpose of this exercise is to put the two elastic bands around the pieces of tagboard so that the elastic bands cross each other.

The teacher should see that the children start at the same time. Time should be kept from the start of exercise until five children have completed task.

The task should then be repeated. Elastic bands should be removed and put on desks. This time the teacher should say, "Now we're going to see if we can work faster. We'll allow you _____ seconds/minutes (the time it took the first five children to compete task). Let's see how many of you can put the elastic bands crossways on the tagboard in this time." The teacher should try to get the children to understand that it is possible for each child to improve his own rate of speed in working. Special recognition should be given to those who finished the task faster the second time.

Eighth Day

Exercise 22: Verbal Response

Procedure. Teacher introduces the idea of "taking a trip". It's interesting and fun to go places, to see relatives or to see friends. It's also interesting to go to new places or to go back to see old places. The teacher should lead discussion about how we travel to different places -- walk to our neighbors, take a bus downtown, a train, airplane, and so on. When the children have had an opportunity to think of different places to visit and means of travel, the teacher then introduces the ideational exercise. The teacher says, "If you could go anywhere you want to after school today, where would you like to go?"

Children take turns answering. All responses are positively reinforced. If children repeat each other's answers, say to the class, not to individual child, "It's fun to go to different places, let's see if we can think of some new places to go".

Exercise 23: Following Directions

Materials. Two coding pages in children's workbook involving triad 123, pencils.

Procedure. Children are instructed to fill in the right numbers under the printed numbers. Time from beginning of exercise until the first five children finish. These children are named "fast workers". The exercise is repeated. Allow the same time as for first trial. Remind the children that they can increase their speed and that this time all children who finish within _____ (the time for first five to finish in first trial) will be named "champion workers".

Exercise 24: Manipulation

Materials. Blank sheet of paper, scissors and pencil for each child.

Procedure. The purpose of this exercise is to fold the paper to make a booklet and to number the pages. The children are shown the model. They are instructed to fold the paper so that the top edge of the paper will be folded to be even with the bottom edge. Make a crease along the fold (now the top of the paper). Then fold the left edge over to the right edge. This makes a fold on the left. The sheet is now folded to be ¼ its size. There are 4 pages in the "booklet". However the first two pages need cutting along the fold, as do the last two pages. The children should cut these pages along the folds. Keep booklet folded on the left or "binding" side of booklet. The children now have an eight page booklet. They are instructed to number the pages in correct sequence. Those who finish first are named "fast workers".

Ninth Day

Exercise 25: Verbal Response

Materials. Picture of a cat.

Procedure. A picture of a cat is shown to the children. The teacher says, "Do you remember what rhyming words are?" (The Binet definition is given: "A rhyming word is a word that sounds like another word. Two words rhyme if they end in the same sound") "What do you think rhymes with 'cat'?" Each child is given a turn. Children are encouraged to respond and may be given help in thinking of a word.

A second "go around" is given. The children are reminded that it's fun to think fast and to answer fast. They are asked to respond as quickly as possible. Count how many responses are made in one minute.

A third word rhyming turn is given. Again count how many responses are made in a minute. If this third trial shows that children can speed up in their responses, teacher points this out to them. Children are praised for their fast thinking and response.

Exercise 26: Following Directions

Materials. Two blank sheets of paper and pencils for each child. Outline picture of dog to be traced.

Procedure. Children are given a blank sheet of paper and instructed to make as many plus (+) and minus (-) marks as they can. Task is timed at one minute. Each child is to count the number of plus and minus marks he or she made. Write this number on page.

The second sheet of paper is given each child. The instructions are repeated. Task is again timed at one minute. Children count the + and - marks on this page. Each child compares the number of marks made the second time with the number made the first. Those children who have increased their speed in working (made more marks the second trial) are named champion workers.

Outline picture of dog is given to each child. Children are instructed to trace dotted line as quickly as possible. The five finishing first are named fast workers.

Exercise 27: Manipulation

Materials. Small bag for each child containing three large screws and three matching nuts.

Procedure. Children are to remove elastic band which secures the bag, and put this inside the bag. The screws with nuts screwed on are removed from bag. Children should unscrew the nuts from screws. They should be given time to examine the six screws and nuts. The teacher should point out that there are three sizes of screws and also three sizes of nuts. The nuts will only fit the screws that they match. Children should be allowed a short time to experiment with the screws and nuts. When the teacher is sure the children understand how the screws and nuts work, the game should begin. Nuts and screws should be separate on desk. When teacher gives begin signal, children should put correct nuts and screws together and screw nut as far as possible on the screw. Time should be clocked when the first five finish. The task should be repeated and the same time allowed for second trial. The winners are those children who finish within the allotted time.

Recognition should be given those who increased their speed.

Tenth Day

Exercise 28: Verbal Response

Materials. A bag with a "secret" object inside.

Procedure. Teacher takes out the bag and explains that there is a familiar object in the bag, and that the children are to guess what it is. The children may ask any question but they must be worded in such a way that the teacher can answer "yes" or "no". Turns should be taken in asking questions and guessing. All children should be encouraged to participate, and to ask questions quickly. (object is a yoyo)

Exercise 29: Following Directions

Material. Page from children's workbook of a little boy going to school.

Procedure. Children are asked to count the number of squares found in picture. Allow one minute for children to look. Have children write number found in corner of picture. See who found the most in a minute. The five who found the most squares in a minute are called champion workers.

Exercise 30: Manipulation

Materials. Three sheets of numbered paper and a paper clip for each child.

Procedure. The children are instructed to put the sheets of paper in order -- that is, the top sheet one, the middle two and the third or bottom sheets, three. When the sheets are in order, the paper clip should be put in the left corner of the paper. The time should be clocked for the first trial.

This exercise should be repeated to see if more children can finish in the time for the first trial. Those children who increased their speed should be called the champion workers.

Eleventh Day

Exercise 31: Verbal Response

Materials. Book *Wheels*.

Procedure. As a means of motivating ideational thought the book *wheels* was shown to the class. Children are asked to name the various kinds of vehicles using wheels, as the pictures in the book are shown. Brief discussion of the many things we see or use that use wheels.

Exercise 32: Following Directions

Materials. Two blank sheets of paper and pencil for each child.

Procedure. Children are given first sheet of paper and instructed to write the triad 123 as many times as they can in one minute. The number is written at top of each child's paper.

The teacher explains that the second sheet of paper is to be used in the same way. This time each child is to see if he can write 123 triads more than before. Again the number of 123 groups written is recorded at the top of each child's paper. The children who increased the number of triads written the second time are declared to be the fastest workers of this exercise.

Exercise 33: Manipulation

Materials. Envelope for each child containing 10 paper clips.

Procedure. The teacher explains that this is a speed game. The children are to hook the 10 paper clips in a chain. Before the children start the teacher shows the children how two clips can be hooked together. The children practice fastening the first two paper clips together. The teacher should help any children who need help in understanding how this is done. Then the game begins. Time is kept until the first five children have completed this task. These children are named the "fast workers".

The second part of the game is played in reversing the procedure. The paper clips are unfastened and laid separately on the child's desk. At the end of the same amount of time needed for first five children to complete fastening, time is called again. Those children that had unfastened the most paper clips are named "fast workers". Children are to be complimented for working fast. If more than five children unfastened in the given time, the teacher can point out how the children are learning to work faster.

Twelfth Day

Exercise 34: Verbal Response

Materials. Book Wheels.

Procedure. The children are again shown the book Wheels briefly. Then they are told that this time each child is to take turns in naming something that has wheels. They are to respond as quickly as possible. Teachers favorably reinforce children's responses.

Exercise 35: Following Directions

Materials. Broken line drawing of rabbit from children's workbook, pencil.

Procedure. The children are instructed to trace over the broken outlines of the rabbit as quickly as possible. The first five children to finish are named "fast workers".

A review of the words rhyming with cat is done quickly. Then the children are told that they're going to do a new rhyming game with the word "ball". They are to think (silently) of words that rhyme with "ball". When the game starts they are to take turns saying these words as quickly as possible. Teacher should encourage and verbally reward those children who respond quickly.

Exercise 36: Manipulation

Materials. Book for each child, 3 bookmarks for each child.

Procedure. Children are instructed to get out books. They are given the three bookmarkers. They are told they are to find the three pages that you tell them, and put markers at each page. The markers should extend above the top of the book. The page numbers should be put on the chalkboard as well as called aloud. The page numbers are 8, 20 and 25.

Time should be clocked when the first five children have found the three pages and placed their bookmarkers. The children finishing first are called "fast workers". All children should find pages before second half of game. When all have found pages, the bookmarkers are removed and the exercise repeated.

The same time should be allotted. The object is to see if more than five children can find the three pages and place bookmarkers on the second trial. All children who finish within the allotted time are called "champion workers".

Thirteenth Day

Exercise 37: Verbal Response

Procedure. Review of Wheels. Children are asked to name as many things having wheels as possible without stopping. Teacher should tell the children to think of things silently so that when their turn comes they'll be able to answer quickly. Teacher should positively reinforce all responses.

Exercise 38: Following Directions

Materials. Two identical pages from children's workbook which are filled with squares in which A, B, 1, 2's are placed at random; pencil.

Procedure. Children are given the first page and told to mark out all the A's and B's as quickly as possible. Time is clocked when the first five are finished.

Teacher should remind children that the "winners" in this game are those who increase their own speed of working. Tell the children that it is important to 1) be ready 2) listen carefully to instructions 3) keep attention on the work at hand. If these three rules are remembered, speed of working will usually be increased. Then the second sheet is given. The children are instructed to mark out 1's and 2's. The object is to see if more than 5 children can finish in the clocked time of the first part of exercise. Teacher should give favorable verbal reinforcement to all children who respond (that is try to increase speed). "You're getting faster", etc. The children who finish within the clocked time are declared the winners of this exercise.

Exercise 39: Manipulation

Materials. Blank sheets of paper for each child, scissors, crayons.

Procedure. This is a review exercise of folding paper to make a booklet. (See Exercise 24, 8th day) The added tasks are: first, to number each page (there should be eight pages) with a crayon, second, to add the first eight letters to the pages in consecutive order. All children should finish booklet. Teacher should encourage children to their ability levels. Care should be taken that no child become discouraged. Emphasize that the important thing is to increase one's own speed with each exercise.

Fourteenth Day

Exercise 40: Verbal Response

This is an exercise in the association of ideas and verbal response. The children are asked to think of as many kinds of animals as possible. Then, taking turns, the children name an animal (domestic or wild). If children name the same animals repeatedly, the teacher should suggest to the class as a whole that it would be interesting to try to think of different kinds. Teacher should name a few if responses lag. The teacher should try to keep the tempo of response as fast as possible. When everyone has had a turn, the teacher should introduce a second idea of naming the animal and then adding the name of its young, i.e., cat - kitten; dog - puppy; cow - calf, etc. Then the exercise can be repeated. The children should name the animal and the name of its young. Children should be encouraged to respond as quickly as possible.

Exercise 41: Following Directions

Materials. Two pages from children's workbook, coding ABC, pencils

Procedure. Children are instructed to write A, B or C in the blank squares under the matching letters. Time is clocked when first five finish. These children are recognized as fast workers. The second sheet is completed in the same way as the first. The same time is clocked. The object is to see if more children than the first time can finish in the allotted time. All those who finish within the allotted time are called the "fastest workers".

Exercise 42: Manipulation

Materials. One turn buckle for each child.

Procedure. Children are each given one turn buckle. This is an oblong metal buckle in which a screw is screwed in each end. The children are to unscrew both screws and put the three pieces (buckle and two screws) on their desks. Check the time for the first five children to finish. The first five children to finish are recognized as fast workers.

When all of the children have their screws out, they are told that they are to replace both screws and screw them in place as far as they will go. The first five children to finish are recognized as fast workers.

If time permits this manipulatory exercise may be repeated with emphasis on children trying to work faster. It is important for children to realize that they can increase their speed of work.

Fifteenth Day

Exercise 43: Verbal Response

Procedure. This is a review of the animal response exercise. The added task is for the children to take turns telling something about animals they have seen or known. The animals can be pets, animals seen in a circus or zoo, on T.V., etc. The verbal response should describe the animal or animal's actions, etc. This should be done quickly in no more than two or three sentences for each description. Teacher should express interest, enthusiasm and encouragement for responses.

Exercise 44: Following Directions

Materials. Two sheets from children's workbook (ABC, 123 mark out) pencils.

Procedure. The children are given the first sheet and instructed to mark out all of the A, B, and C's on the page. Time is clocked when the last child is finished. Teacher tells the children how long it has taken the whole class to finish. The object of this game is to see how fast the class can finish the second page when the 1, 2, and 3's are marked out. The teacher should explain that if the second time is shorter than the first that all the children in the class will be called very fast workers and they'll all be champion workers. The second page is begun and clocked.

Exercise 45: Manipulation

Materials. Sheets of paper marked in three sections with different design in each section (1 sheet for each child), construction paper shapes used on the fifth day (exercise 15).

Procedure. This exercise reuses the 15 construction paper items used on the fifth day in exercise 15. Color is not a factor to be considered in this exercise. The sorting of the shapes and the speed with which the child can transfer the shapes to the sorting page are important.

Right-handed children should place the sheet of paper on left side of desk, the construction paper shapes on the right side of desk. Left-handed children should reverse this. The object of this game is to put all the shapes in the matching section of the sheet of paper. Time should be clocked until all children are finished. Again children should be reminded that the second trial will give each child a chance to increase his speed of work. If the second trial can be completed in less time than the first, the children will all be called "champion workers". Teacher should show enthusiasm and approval of the childrens improvement in working fast.

When this exercise is finished the construction paper shapes should be returned to fifth day packet.

Sixteenth Day

Exercise 46: Verbal Response

Procedure. This is a verbal response task in which the children are asked to name articles of clothing. The teacher should initiate a discussion of clothing, the different clothing worn by boys and girls, the different clothing worn in winter and summer, the different clothing worn for sports and dress-up occasions, etc.

The children are then asked as quickly as possible to each name an article of clothing in turn. If a child has difficulty in thinking quickly, the teacher should give clues such as "What do we wear on our hands in winter?" or whatever is appropriate to help the child in responding. No child should miss the opportunity to make a successful response.

In the second part of this exercise, the children should take turns naming as many items of clothing as quickly as possible without stopping. Repetitions are accepted. The object is to see how many items the children can recall when responding. The teacher should talk about the importance and fun of being able to think and respond quickly.

A list of clothing items mentioned by the children should be made. This list will be used in the next verbal response exercise.

Exercise 47: Following Directions

Materials. Page from children's workbook of Mexican child.

Procedure. This is an embedded figure task in which the children find and count all the triangles. The triangular shape should be put on chalkboard. Then the teacher should explain to the children that these triangles are hidden in many different ways, and that they have to "hunt" for them. This is a game in which the object is "Who can find the most triangles first?" Pictures may be used for crayoning when exercise is finished.

Exercise 48: Manipulation

Materials. Five pages of paper number 1-5 for each child; one paper clip.

Procedure. Children are instructed to

1) arrange the pages in correct sequence from 1-5.

2) put the paper clip on the top of the left hand corner.

3) to fold the pages in thirds (see teacher's model).

The teacher should demonstrate each of these steps so that each child understands what is to be done.

This exercise is done twice. Time is clocked for the first trial at the end of the time when all children finish. Again the teacher should explain that everyone should work faster the second trial to see if the class can finish in less time than the first trial. All children who finish within the allotted time are declared winners of this exercise. Teacher should give verbal reinforcement, "You're learning to work faster", etc.

Seventeenth Day

Exercise 49: Verbal Response

Procedure. This exercise is an extension of the verbal response exercise 46 of the previous day. The teacher calls the names of the articles of clothing named by the children. As each item is called the children make up a sentence that tells something about this item. For example, "shoes" - response "We wear shoes on our feet", or "Shoes are usually made of leather", or "My shoes are brown". Any response related to items named is accepted with positive reinforcement from the teacher. All children are encouraged to respond. No child is left out. If child has difficulty in expressing himself, teacher should give helpful clues. Responding should be a rewarding and satisfactory experience for the child.

Exercise 50: Following Directions

Materials. Pages from childrens workbook which have two "follow the dots" exercises on each page; pencils.

Procedure. Children are instructed to follow the dots by the numerical numbers in sequence. The diagram at the top of the page should be done first. Clock the time when all the children are finished.

The teacher should point out that the next diagram has two extra numbers. The object of this game is to do the second diagram (which is longer) in the same time that it took the class to finish the first diagram. Tell the children that this will prove that they can learn to work faster.

The second half of the page is clocked at the same time as the first. The children who finished the second half in this time are declared the winners of this game.

The triangles in this exercise may be later crayoned to make a pretty mosaic.

Exercise 51: Manipulation

Materials. 10 sheets of notebook paper (with 3 holes on left side) and three brads for each child; pencils.

Procedure. The children are instructed to number the 10 sheets of paper from 1-10. The sheets are to be arranged in order from page 1 to page 10. The children are then to put the three brads in the three holes of the notebook paper and open and bend backwards the two ends of the brads so as to secure the paper tightly together. The teacher should demonstrate how this is done so that children will understand what is expected of them. The children are to work as quickly as possible to make their booklets. These booklets may be kept by the children to be used in their school work. All children should have successful experience in making booklet. Teacher should positively reinforce the efforts of children who work quickly.

Eighteenth Day

Exercise 52: Verbal Response

Procedure. This verbal response exercise is the association of words and ideas relating to home furnishings. The teacher should lead the discussion of what kinds of furniture and appliances are found in the home. Discussion of the various rooms - kitchen, livingroom, bedroom and their furniture should preceed this exercise.

The children are given a turn to name any items of furniture usually found in the home. After this is finished the children should take turns naming as many items of furniture as possible without pausing. Again repetition is permitted, but if there is too much repetition the teacher should suggest to the class as a whole that they think of all the rooms in a house. Children who have difficulty should be given clues so that every child experiences success and satisfaction in responding. Teacher should keep a list of furniture named for exercise 55.

Exercise 53: Following Directions

Materials. Pages from children's workbook with "follow the dot" sequence of drawing lines between numbers, pencil.

Procedure. The teacher should explain that this page is different in that no lines should be drawn between the heavy lines that divide the page in three sections. A page should be held up when this is explained so that all children understand where the dividing lines are. The children all start at one time. Tell the children there is a hidden meaning in this design. Who can find it first? The exercise is not completed until all children finish and can read the message they have written.

Exercise 54: Manipulation

Materials. A small bag for each child which contains three small screws and nuts to match.

Procedure. Children should remove elastic band and put it inside the bag. The screws should then be removed. The nuts will be screwed on the screw. Children should remove the nuts. The teacher should point out that these screws and the matching nuts are of three different sizes. The nuts will only fit the screws that they belong on.

When this game begins the nuts and screws should all be separated on the children's desks. Time should be clocked until all nuts are screwed as far as possible on the screw. The nuts are again removed. The object of the second trial is to see if the nuts can be screwed on faster on the second trial than the first trial. The class wins their game if all nuts can be screwed on faster than the first trial.

The screws and nuts should be replaced in bags and elastic band put around the bag.

Nineteenth Day

Exercise 55: Verbal Response

Procedure. This exercise is an extension of Exercise 52 (naming furniture or appliances of the home). The teacher uses the list resulting from Exercise 52. As the teacher reads the names of the pieces of furniture, the children take turns making up sentences relating to these names. For instance, table - "A table is something we eat on" or "The table is made of wood", etc. The children should be encouraged to respond to the word given by the teacher as quickly as possible. If a child has difficulty thinking of a sentence, the teacher should give helpful hints so that the child can make a successful response. The teacher should positively reinforce responses. "You have good ideas", "You answered quickly", "That's interesting", etc .

Exercise 56: Following Directions.

Materials. Two unlike pages with designs for drawing pictures, crayons.

Procedure. The teacher should show page with two lines on it. She should say, "I want you to look at this sheet of paper and use your imagination. Don't say anything out loud. Just think. What does this look like to you? You may turn the page in any direction you want to. (Teacher should turn sheet of paper completely around) Each one of you may imagine something different. You're to take this page and draw a picture. The lines on the page can be a part of your picture. You may draw anything you want to."

Children should be allowed about 5 minutes to draw a simple picture.

The second sheet (with one crooked line) is then shown to the children. They are told that this design might make them think of a different idea for a picture. Again they are to draw a picture using the design on the paper to be a part of the picture. The children should be encouraged to express their imagination. If a child finds difficulty in thinking of an idea the teacher may help by saying, "What does this line make you think of?" Turn the sheet several directions. Rather than have a child delay too long, suggest that the line might be a part of a design - in other words, the child can make random lines and then crayon the various shapes different colors.

These pictures should be saved for Exercises 58 & 59 on the following day.

Exercise 57: Manipulation

Materials. Two sheets of paper, one paper clip, one envelope, for each child.

Procedure. The children are to put the two sheets of paper together evenly, secure the two sheets by placing the paper clip in the left hand corner at the top of the paper, then fold. The teacher should demonstrate this. The "letter" should then be put in envelope. The children should clearly understand what they are to do before exercise starts. The first five children to finish first are recognized as fast workers. All children should complete exercise as quickly as possible. If time permits this exercise may be timed and repeated a second time so that children can see if they can increase their speed.

Twentieth Day

Exercise 58 &
Exercise 59: Verbal Response and Following Directions are combined

Materials. Sheets of paper with V design, crayons.

Procedure. Children are given one sheet of paper with V design and crayons. Instructions are the same as for Exercise 56. The children now have three pictures they have drawn (including Exercise 56).

For verbal response exercise the children are to choose one of the three pictures to talk about. The children take turns telling a "story", about the picture. This can be an imaginary story which the picture illustrates or it can be naming the things in the picture. If the child has difficulty in telling about his picture, the teacher should point out interesting things in the picture, etc., to help him get started. The teacher should encourage verbalization by favorable comments, etc.

Exercise 60: Manipulation

Materials. Package of screws and nuts used in Exercise 27 on the 9th day, 1 sheet of paper with designs for sorting for each child.

Procedure. Children should put the nuts and screws on the right side of their desks and the sorting sheet on the left. This should be reversed for left-handed children. The nuts should be unscrewed so that the six items are separate. The object of this exercise is to put each nut and screw on the correct section (matching illustration) of the sorting sheet. Only one hand should be used and one item picked up at the time. Time should be clocked when all children have transferred all six items to the sorting sheet.

This exercise should be repeated. The children should be reminded that they can all be "winners" if they can work faster on the second trial. Time again should be clocked when all six items have been transferred to the sorting sheet. If the second trial is shorter than the first all children should be declared "champion" because they have learned to work faster. The nuts should be screwed on the screws as far as possible, then returned to the bag and the elastic band secured around the package.

APPENDIX D

THE FACTOR ANALYSIS OF THE FLEXIBILITY TESTS

THE FACTOR ANALYSIS OF THE FLEXIBILITY TESTS

Introduction

As previously stated, the purpose of this research was to test the general hypothesis that special training procedures are effective in facilitating the development of cognitive flexibility in retarded and normal children, and that these procedures also improve performance on cognitive tasks that are independent of the training procedure employed. However, previous research has failed to supply adequate criteria whereby flexibility in children can be operationally defined. Moreover, various inconsistencies in the reported factor analyses of flexibility tests prohibit a generalization from these studies to the cognitive behavior of children. Therefore, it was considered necessary that special tests be developed for this purpose and a preliminary factor analysis be carried out. It was believed that this procedure would serve two purposes: it would provide a test of the hypothesis of a general factor of flexibility in normal and retarded children, and it would result in an adequate operational definition of flexibility.

A review of the factor analytic literature concerning those flexibility tests most suited for children suggests that the types of behaviors relevant to the construct of flexibility can be divided into three areas: perceptual, conceptual and spontaneous flexibility. Perceptual flexibility refers to the ability to order or categorize a stimulus array in several ways, to build temporal Gestalts readily and to break them down into their separate parts upon environmental demand. Stated more simply, this type of flexibility involves the ability to restructure one's perceptual field. Operational definitions of this kind of flexibility are found in performance on such tests as stencil design, reversible figures and embedded figures. Conceptual flexibility is defined as the ability to re-order or categorize stimuli by mediation, i.e., to form concepts, to re-order these concepts upon demand and to shift the original elements so as to arrive at new and different concepts. Such tests as card sorting, object sorting and similarities-differences may be used as operational definitions of this type of flexibility. Spontaneous flexibility, or fluency, is defined as the ability to produce a large number of cognitions in a limited amount of time and to shift in this production so as to arrive at relatively new responses within sequences of output. The traditional fluency tests such as word naming, object naming or brick uses serve to define this kind of flexibility.

Although tests of cognitive flexibility may be conveniently divided into these three areas for the purpose of analysis, some type of cognitive shifting is assumed to operate in each of these areas. Since young normal and retarded children are assumed to be less differentiated than adults, it was hypothesized that a general factor of flexibility (ability to shift) would appear across these areas, whereas no such factor has been found for adults.

The Test Battery

Nine types of tests were selected from the literature according to several criteria. First, tests were selected that consistently loaded on the flexibility factors in several studies. Within this selection, tests were chosen which had the highest loadings on the flexibility factors. The final nine tests were accepted on the basis of their appropriateness for a retarded and normal population with a mental age range from 6.0 to 8.0 years and for their convenience in administration and scoring. The final battery was composed of the following tests.

Test 1: Stencil Design

Flexibility as measured by this test seems to be most clearly related to the ability to shift perceptually in terms of figure and ground relationships (Corter, 1952; Spitz and Blackman, 1959). The test was composed of 15 items which increased in difficulty according to the number of stencils required and the complexity of the figure-ground arrangement. The stencils were circles with three-inch radii cut from colored cardboard sheets. The colors used were red, green, yellow and white. (A complete description of the administration and scoring procedures is found in Appendix A.)

Test 2: Embedded Figures

Tests involving concealed figures have consistently loaded on flexibility factors (Frick *et al.*, 1951; Dingman, 1958; Chown, 1959). Presumably performance on this test is related to the ability to break a Gestalt down into its parts and to shift in the organization of part-whole relationships. To some extent it seems to involve the ability to overcome Gestalt organizational tendencies, *i.e.*, tendencies to become overcome by the "wholeness" of the figure at the expense of the perception of the parts. Other terms applied to this ability have been "Gestalt rigidity," "Gestalt breaking," and "closure flexibility." The test was composed of 10 items. Each item consisted of a large figure or object drawn on a 5x8 inch card with several parts represented on the same card. Difficulty increased according to the number of figures that were embedded and the complexity of the test figure.

Test 3: Block Design

This test was included to provide an additional measure of the ability to shift figure-ground relationships. Each item was composed of two parts, the test design and the same design with figure and ground reversed. Each design was shown on four-inch square cards. The colors used were red and white. Difficulty increased according to the number of blocks required and the complexity of the figure. Subjects were first required to reproduce the test design, and subsequently the same design with figure and ground reversed. Flexibility was measured by the ability to shift accurately from the first design to the second.

Test 4: Picture Anomalies

Flexibility as measured by this test has been attributed to the ability to shift one's set suddenly when confronted by the unexpected in the form of incongruity or dissonance in perceptual feedback (Corter, 1952). Thus, the individual is required to abandon a previously established concept and to re-order or form new concepts in order to handle the dissonant information conceptually. Also, to some extent this test involves Gestalt breaking, insomuch as anomalies were often represented in the form of some inappropriate part. Therefore, it presumably overlays perceptual and conceptual areas. The test was composed of 20 items. Anomalies were represented by incongruities in pictures either pasted or drawn on 5x8 inch cards. Some items involved missing parts, *e.g.*, a dog without an ear; others involved inappropriate relationships, *e.g.*, a mouse chasing a cat. Although difficulty levels increased with succeeding items, adequate difficulty levels were not established. Therefore, all the items were administered.

Test 5: Similarities-Differences

Flexibility as measured by this test was assumed to involve the ability to shift concepts verbally, *i.e.*, to form concepts of similarity and difference and to shift between them. The test was composed of five pictorial and ten verbal similarities and differences. (See Appendix A for a more complete description.) Also, since this test was assumed to have a large verbal component in factor structure, it was included to provide comparisons between verbal and nonverbal concept formation and shifting.

Test 6: Object Sorting

Flexibility as measured by this test was also assumed to involve the ability to shift concepts; however, on this test subjects were required to restructure the same group of stimuli according to several principles. Concept shifting tasks such as this have been consistently applied as definitions of flexibility for retarded and normal groups (Kounin, 1941; Zigler, 1962). The principles of sorting used in this test were assumed to be essentially nonverbal, *i.e.*, sorting could be achieved without a verbalization of the concepts involved. For example, the subject could sort by using the principle of color without knowing the names for the colors involved. Therefore, the test was included to provide a measure of conceptual flexibility that would not penalize retarded subjects for a lack of verbal concepts. The test was composed of eight items. Each item was constructed from several wooden blocks cut in different shapes and painted different colors. Difficulty level varied according to the types of concepts employed and the number of principles involved in sorting.

Test 7: Card Sorting

The same concept of flexibility assumed to operate in Test 6 was also assumed for this test. However, the items for this test were arranged so as to exclude sorting according to perceptual characteristics alone. Thus, it was assumed that the principles of sorting for this test were mediated by concepts at an abstract representational level as opposed to concrete concepts based on the physical characteristics of the items. Therefore, this test was included to provide some measure of the abstract-concrete dimension with regard to flexible behavior. The test was composed of 12 sets of four 3x4 inch cards on which the pictures of various objects were pasted. Each set of four cards could be sorted into two categories according to two different principles. Items increased in difficulty as a function of the type of concepts involved.

Test 8: Word Naming

Word Naming was included as a test of spontaneous flexibility in the sense that the subject was required to shift rapidly in his production of ideas and was penalized for perseverative responses. The assumed factor structure for this test is essentially the same as that proposed by Guilford with regard to spontaneous flexibility (Frick et al., 1959; Kettner et al., 1959).

Test 9: Tell About This

Although the factor structure of this test was unknown, it was assumed to be essentially the same as that for Word Naming, in that successful performance required rapid shift in the production of ideas. In this sense the Tell About This Test seems to be clearly related to several of Guilford's flexibility-fluency tests such as Brick Uses and Object Synthesis (Frick *et al.*, 1959). On the other hand, rigidity as displayed on this test also seems to be related to the number of different characteristics one perceives for common objects. Thus, rigidity in this context seems to be related to the concept of functional fixedness (Duncker, 1945). The test was composed of ten common objects for which the subjects were asked to name as many characteristics as they could. Since difficulty levels were not determined, all items were administered. (See Appendix A.)

Subjects and Procedure

The subjects were 26 educably retarded children ranging in IQ from 61-74, and 20 first grade students ranging in IQ from 65-113. The mean mental age for the sample was 82.11 months with a standard deviation of 13.30 months. The mean chronological age for the sample was 112.37 months, and the standard deviation was 30.77 months. The average IQ for the sample was 76.85 with a standard deviation of 14.13.

The entire test battery of nine tests was administered individually to each subject in rooms provided by the school. Throughout testing, efforts to gain and maintain rapport were applied as well as the usual procedures advised for individual intelligence testing (Terman and

Merrill, 1960). The tests were administered in the order given above with the instructions found in Appendix A. The same testing procedure was followed for all subjects. The time required to administer the battery varied; however, it usually required one and one half hours under ideal conditions.

First, the means and standard deviations for each test were computed. Since it was desirable that each test be as homogeneous as possible with respect to the internal factor structure, the reliabilities for each test were computed using analysis of variance techniques (Guilford, 1954). Tests found to have reliabilities less than .70 were item analyzed, and items not correlating with the total scores were eliminated. Two tests, Stencil Design and Ojbect Sorting, were found to require item analysis. The means, standard deviations and reliabilities resulting from this procedure are given in Table.1.

The total scores for each test were first intercorrelated using Pearson product-moment correlation coefficients. The matrix of test intercorrelations is presented in Table 2. Centroid factor loadings were extracted from the correlation matrix by the Thurstone complete centroid method and the factor residuals computed (Thurstone, 1947). After the extraction of three factors, it was felt that the factor loadings and residuals were becoming too small to justify further factoring. The centroid factor loadings are shown in Table 3. In order to achieve the best approximation to simple structure, Factors II and III were rotated 45 degrees in two dimensions. Since a very close approximation to simple structure was achieved, further rotation was not required.

Table 1. The means, standard deviations and reliabilities of the tests

Tests	$\bar{X}$	s	r*
Stencil Design	5.93	4.22	.771
Block Design	7.32	7.76	.911
Embedded Figures	17.63	5.10	.727
Similarities-Differences	23.48	12.09	.874
Object Sorting	19.87	8.83	.749
Card Sorting	29.33	9.40	.769
Picture Anomalies	22.00	6.75	.759
Word Naming	15.91	8.59	
Tell About This	36.02	11.61	.932

*Internal consistency as calculated by ANOVA

Table 2. Matrix of intercorrelations*

Test	Test Number	1	2	3	4	5	6	7	8
Stencil Design	1								
Block Design	2	637							
Embedded Figures	3	342	657						
Picture Anomalies	4	328	533	381					
Similarities-Differences	5	290	361	500	655				
Object Sorting	6	371	385	382	500	501			
Card Sorting	7	338	400	175	361	289	587		
Word Naming	8	359	622	472	631	618	562	423	
Tell About This	9	422	642	547	609	636	521	263	748

*Decimal points are omitted

Table 3. The centroid factor loadings

Test	I	II	III	h^2
1	588	-287	-337	5417
2	774	-423	-102	7884
3	650	-303	155	5383
4	735	211	154	6085
5	712	220	371	6922
6	695	320	-217	6325
7	541	265	-454	5690
8	819	121	144	7061
9	812	-073	255	7297

Table 4. The rotated factor loadings

Test	CF	PO	CO
1	588	-441	-035
2	774	-371	227
3	650	-105	324
4	735	258	-040
5	712	418	107
6	695	073	-379
7	541	-134	-508
8	819	187	016
9	812	129	232

The plots of the rotated factors have been shown in Figures 1, 2, and 3, and the rotated factor loadings in Table 4.

Summary of Results

As Table 4 and Figures 1 and 2 show, Factor I emerged as a general factor present in all tests in the battery. Therefore, the hypothesis of a general factor of cognitive flexibility (CF) was supported. In general all the tests in the battery loaded .54 and higher; however, the

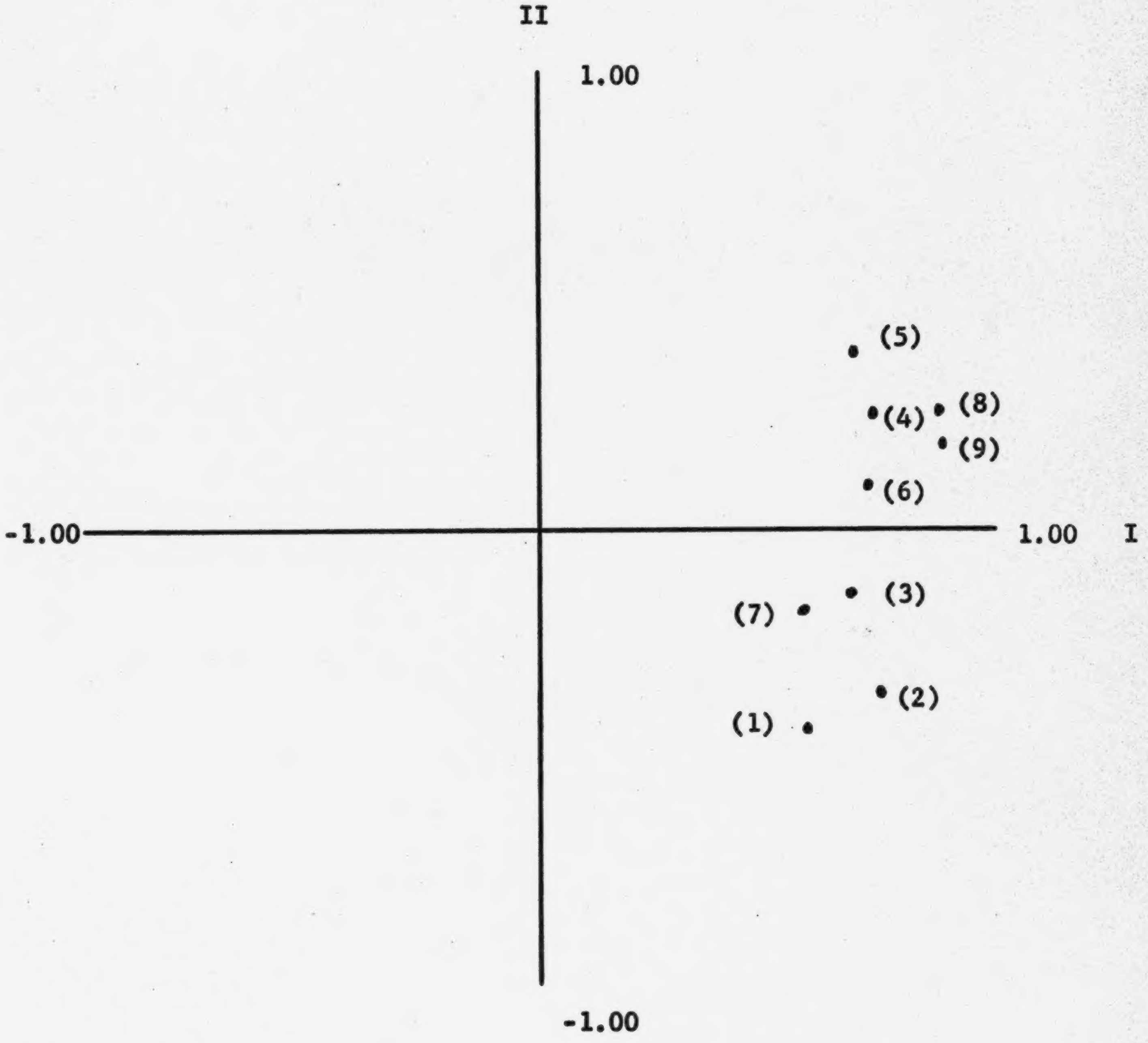


Figure 1. The plot of Factor I on Factor II

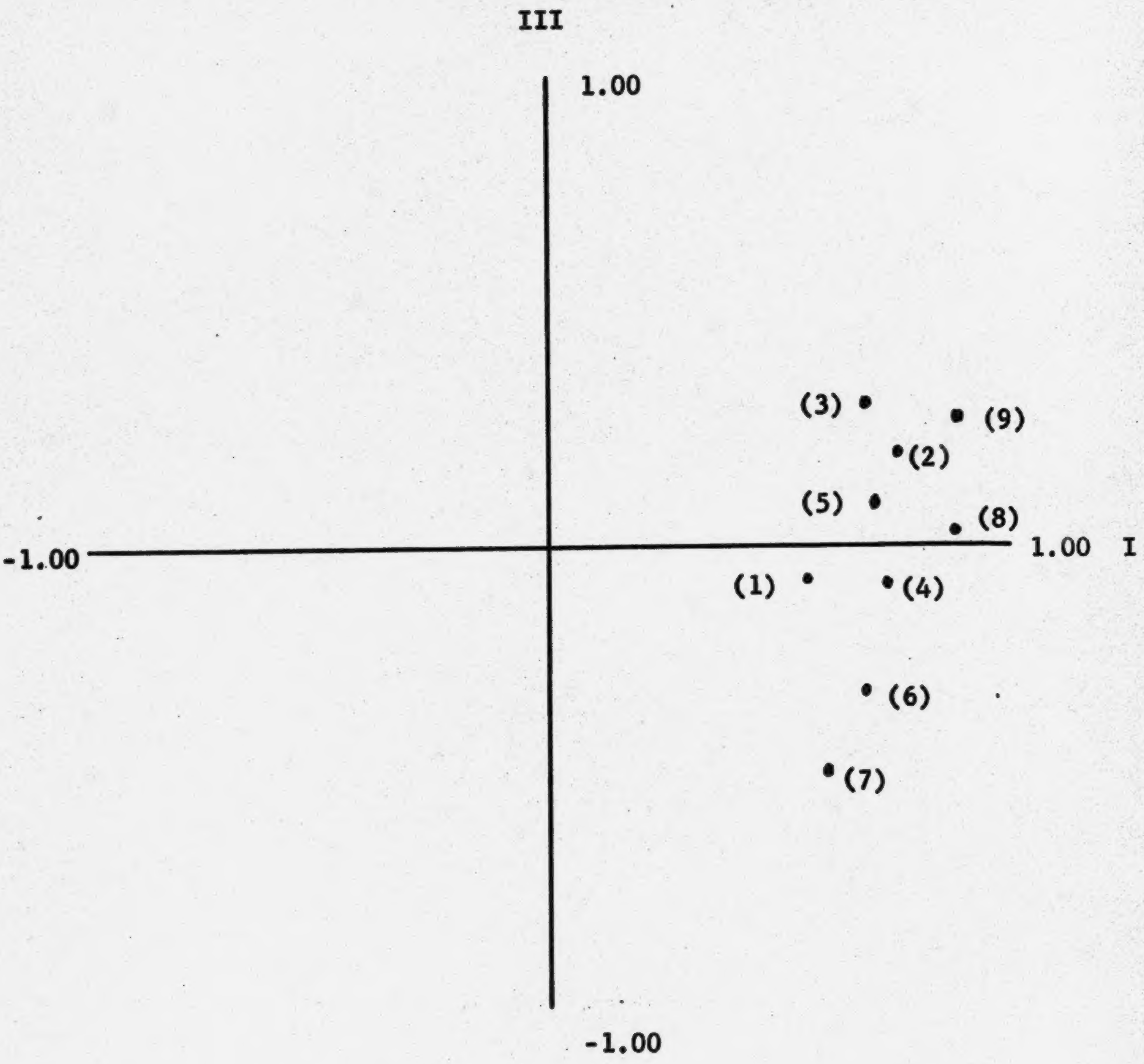


Figure 2. The plot of Factor I on Factor III

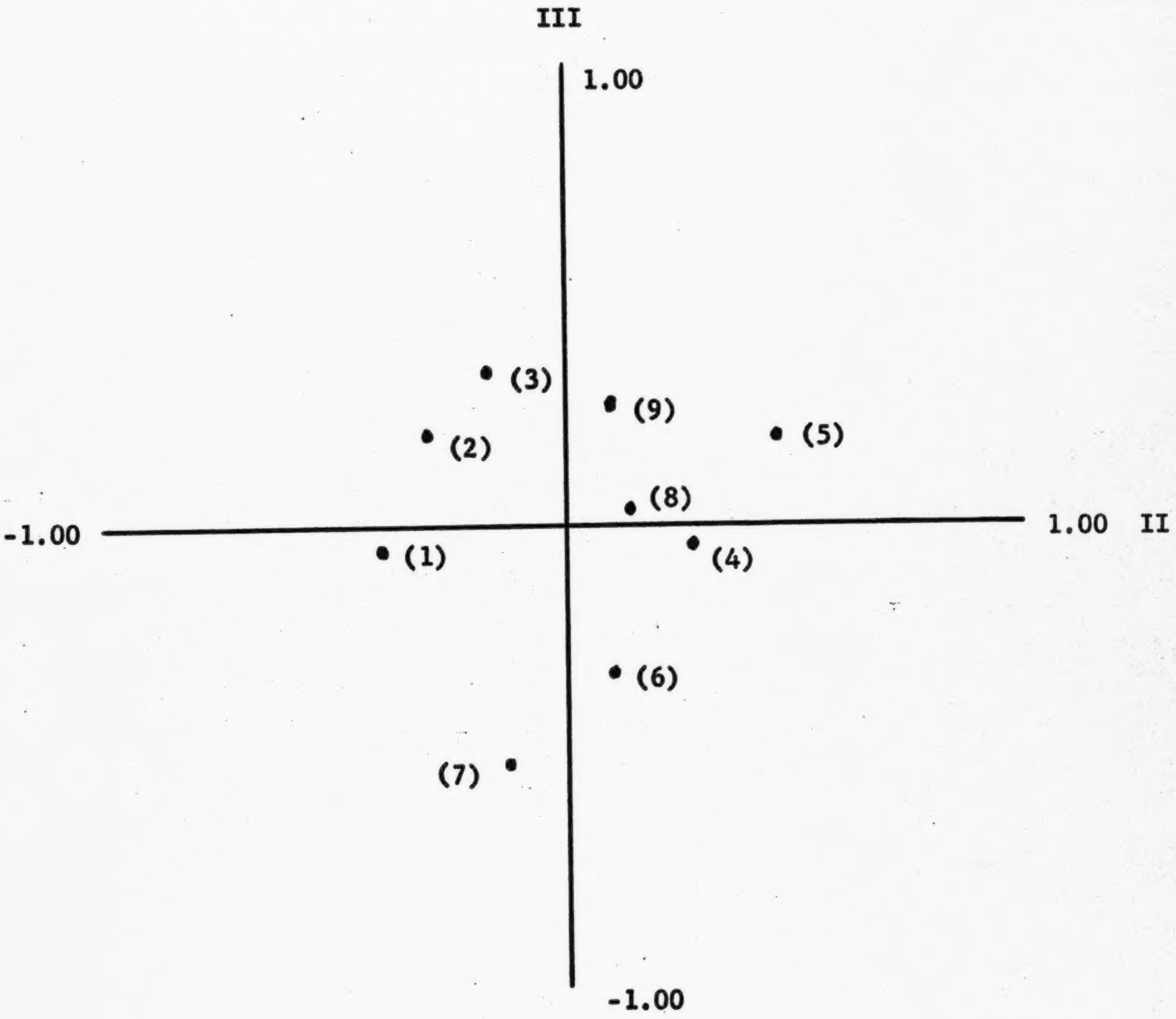


Figure 3. The plot of Factor II on Factor III

factor seemed best defined by Word Naming, Tell About This, Embedded Figures and Picture Anomalies. Since these tests are representative of each of the three hypothesized areas of flexibility, _i.e._, perceptual, conceptual and spontaneous, it is apparent that the general factor of shifting is more important in defining flexibility in children than the idea of separate areas of flexibility characteristic of the construct as it is applied to adults.

Factors II and III were interpreted as bipolar factors arising from the behavioral characteristics of the tests. Factor II seemed to be best defined by Stencil Design and Embedded Figures. Consequently, it was interpreted as being a perceptual organization factor. On the other hand, Factor III seemed to be best defined by Object Sorting and Card Sorting, and it was interpreted as being a conceptual organization factor.

Several limitations must be placed on the generality of these results. First, since the study was exploratory, a relatively small number of subjects was used. Also, the composition of the sample was not sufficiently heterogeneous to permit broad generalizations. Inspection of the sample indicates that only seven subjects fell within the normal range in IQ. Consequently, generalizations concerning the performance of normal children on these tests must be made with caution. In addition, inspection of Table 4 indicates that most tests in the battery have large components of unique factor variance not removed by factor procedures. Therefore, one must conclude that this battery does not represent a "factor-pure" measure of flexibility.

Since the entire test battery would require too much time to be conveniently used in an experimental situation, it was considered necessary to shorten the battery for experimental use. A total of five tests was finally selected for these purposes. Tests were chosen on the basis of their factor loadings on cognitive flexibility, reliability, variation, intercorrelation, difficulty, ease of administration and clinical validity. The final tests were Stencil Design, Embedded Figures, Picture Anomalies, Object Sorting and Tell About This.

Since all of these tests contained components of unique factor variance, optimal weights were computed by multiple regression procedures. The results of this procedure have been summarized in Table 5. As Table 5 shows, the multiple correlation of the weighted sum of test scores in the composite using integral weights, with the flexibility factor, was .89. This was regarded as adequate for the measurement of the factor.

Table 5. The weights for selected tests measuring factor CF and the correlations of the weighted CF score with the CF factor

Composite	Optimal Weights	Multiple Correlation with Factor CF	Integral Weights	Correlation of Weighted Sum with CF
Stencil Design	.534	.9239	10	.8973
Embedded Figures	.037		1	
Picture Anomalies	.413		10	
Object Sorting	.283		5	
Tell About This	.035		1	

Since the primary purpose of the factor analysis was to test the hypothesis of a general factor of flexibility, only those tests hypothesized to measure flexibility were included in the battery. Consequently, it was considered necessary to determine the relationship between CF factor scores and general intelligence independently of the factor analytic procedure.

Pearson product-moment correlation coefficients were computed between CF total score and Binet IQ, MA and CA for the factor sample of 46 subjects. The correlation between CF and IQ was -.196; the correlation between CF and MA was .734; and between CF and CA, .575. Thus, the CF total score seemed to vary as a function of developmental level, *i.e.*, MA and CA, but bore little relation to the IQ at a particular developmental level. In order to determine the validity of this interpretation, the same coefficients were computed for the total experimental sample of 64 bright normal and retarded children (see Table 7). Coefficients of correlation were first computed separately for the retarded and normal groups and then for the entire sample. These results are presented in Table 6. As Table 6 shows, the correlation between CF and IQ scores was moderate and was slightly higher for the retarded sample; however, it dropped considerably when the two samples were combined. On the other, hand, the correlation between CF and MA was high and remained fairly constant across samples. The greatest differences in correlation across samples were noted in the correlations between CF and CA. Although CF showed a moderate relationship with CA in the normal group, it failed to correlate with CA in the retarded group; and the relationship became negative when the samples were combined.

In order to explain these findings, partial correlation coefficients were computed between CF, IQ and MA with the effects of CA removed. The partial correlation between CF and IQ with CA constant for the normal sample was .699, and that for the retarded sample was .697. The partial

Table 6. The Pearson product-moment correlation coefficients between CF total score and each Stanford-Binet test variable

	Group		
	Normal	Retarded	Total Sample
N	32	32	64
IQ	.515	.681	.399
MA	.754	.715	.693
CA	.419	.058	-.156

correlation between CF and MA with CA constant was .721 for the normal sample and .734 for the retarded sample. Therefore, it was concluded that chronological age did not contribute to the relationship between CF and IQ and between CF and MA. In order to clarify further the relationship between CF and IQ, partial correlation coefficients were computed between CF and IQ with MA removed for each sample. These coefficients were -.307 for the normal group and .255 for the retarded group.

Thus, it may be concluded that the relationship between CF factor scores and Stanford-Binet IQ was determined primarily by the relationship between CF factor scores and mental age, and that chronological age failed to contribute to either relationship. These results imply that cognitive flexibility as measured by CF total score varies primarily as a function of mental age, *i.e.*, developmental level, rather than as a function of intelligence at a particular developmental level.

APPENDIX E

THE COGNITIVE TRAINING EXPERIMENTAL TEST BATTERY

1. SIMILARITIES AND DIFFERENCES CONCEPT FORMATION (SD)
2. COGNITIVE FLEXIBILITY (CF)
3. PRODUCTIVITY - RESPONSIVENESS (PR)

(Description, Directions, Scoring and Record Form)

The Similarities-Differences Test Battery

PART I. COLORED FORMS

Instructions

"See these red circles? They are all alike, aren't they? All the same? But see these circles? They are not all alike; not all the same. Put your finger on the one that is different."

Show S if he selects the wrong one. After S has located the red circle, say: "Why is the red one different? Yes, it is red; and how are the others the same or alike?" If S is unable to respond to either question, supply the correct answer and proceed to the next part.

Introduce all other items by saying: "Now look at these cards. ARE THESE ALIKE, ARE THEY THE SAME? IF THEY ARE NOT THE SAME, PUT YOUR FINGER ON THE ONE THAT IS DIFFERENT FROM THE OTHERS. HOW IS IT DIFFERENT?"

If S says several are different, say: "Which is the MOST different?"

Scoring

Give one point for the recognition of a difference, and one point for the correct reason why it is different. Two points are given for those items in which S correctly says they are all alike. (16 items - 20 possible points)

PART II. FORMS

Instructions

Items 1-6: "See these two forms? Are they alike, are they the same?" Use the same instructions for items 1 through 6.

Items 7-16: "Now we're going to see if you can tell when two things are the same shape or form even when they are different in other ways. (present item D1) For example, these two are both circles, but one is red and one is white; (present item D2) but, these two shapes are not the same, although they are both red. (present item 7) NOW LOOK AT THESE. ARE THEY THE SAME FORM OR SHAPE?"

Continue using these instructions for the rest of the items. If necessary, correct responses to items 9 and 10; however, give no help thereafter.

Scoring

Two points for each correct answer. Do not score items 7 and 8. (32 possible points)

PART III. ANIMALS

Instructions

Items 1-5; "See these two animals? Are these two the same kind of animal? Are they alike?"

Items 6-16: Present item D1 and say: "These two elephants are just alike, aren't they? (present item D2) But these two are not alike - not the same animal. One is a cow and one is a dog. (present item 6) Now, on this card we have two dogs that are not exactly alike, but they are both dogs. When I show you the next few cards, I want you to tell me if they are the same kind of animal or not. For example, if they are two dogs, you would say they are the same; however, if they are a dog and a cat, you would say they are different."

"NOW LOOK AT THESE TWO. ARE THEY THE SAME KIND OF ANIMAL?"

Scoring

Score two points for each correct answer. (30 possible points)

PART IV. ABSTRACT FORMS

Instructions

"SEE THESE FIGURES? ARE THEY ALIKE, ARE THEY THE SAME?" If S says 'no', ask which is different.

Scoring

Two points for each correct response. S must point out the different parts. (16 possible points)

PART V. PICTORIAL DIFFERENCES

Instructions

"One of these pictures is different from the others. PUT YOUR FINGER ON THE ONE THAT IS DIFFERENT. WHY IS IT DIFFERENT?"

Scoring

One point is given for the recognition of the different part and one point for the correct verbalization of the difference. In order to score two points, S must conceptualize how the similar items are alike, e.g., "The scissors are different because the others can't cut." (one point) "The scissors are different because you eat the others." (two points) DISCONTINUE three consecutive failures.

PART VI. PICTORIAL SIMILARITIES

Instructions

"These pictures are all alike, all the same, in some way. Tell me how they are the same." Present card D1 and say: "That's right, they are both squares," or say: "See, they are both squares." Present card D2 and say: "Now look at these two figures. See, they are both circles, but one is yellow and one is bigger than the other one. Now tell me how these two figures are the same." If S responds with a difference, correct him by saying," Yes, but how are they alike? How are they the same?" Use this prompting procedure for the first two cards only.

Present the rest of the items by saying, "TELL ME HOW THESE TWO ARE ALIKE."

Scoring

Score either 2, 1, or 0 points. See scoring criterion. DISCONTINUE three consecutive failures.

PART VII. VERBAL DIFFERENCES

Instructions

"Now I am going to name two things and I want you to tell me how they are different. IN WHAT WAY ARE A kitten AND A cat DIFFERENT?"

Scoring

Score either 2, 1, or 0. See scoring criterion. DISCONTINUE three consecutive failures.

PART VIII. VERBAL SIMILARITIES

Instructions

"Now I am going to name two things and I want you to tell me how they are alike, how they are the same. IN WHAT WAY ARE A basketball AND AN orange BOTH ALIKE? HOW ARE THEY THE SAME?"

If S responds with a difference, correct him by saying, "Yes, but how are they alike?" Use this prompting procedure for the first three items only.

Scoring

Score either 2, 1, or 0. See scoring criterion. DISCONTINUE three consecutive failures.

Scoring Criteria for Specific Tests

The Similarities-Differences Test

PART V. PICTORIAL DIFFERENCES

One point credit is given for correctly picking out the different items. One point credit is given also for giving the correct reason why it is different. Credit is not given for describing characteristics of the item that is different rather than the characteristics of the like items. Typical one and two point responses are listed below.

1. The bowl has a different design - figure -- top -- etc. (2 points)
   This bowl has a crooked top. (1 point)
2. The other two pictures have the trees between (next to, on the inside, etc.) the two houses. (2 points)
   The small house is in a different place. (1 point)
3. The hammer is not a fruit -- cannot be eaten. (2 points)
   You can't build with the others. (1 point)
4. This is not a flower -- doesn't grow. (2 points)
   The others don't keep the rain off. (1 point)
5. The scissors are not vegetables -- you don't eat them. (2 points)
   The others can't cut -- aren't made of metal. (1 point)
6. The toy can't be worn -- is not shoes. (2 points)
   You play with the box. (1 point)
7. You don't put on the basket -- clothes -- wear others. (2 points)
   You carry clothes in the basket. (1 point)
8. You can't do the floor with a pear -- not used for cleaning, used in house. (2 points)
   The others are not to eat. A pear tastes good. (1 point)
9. You have to push the wagon -- others have motors. (2 points)
   The wagon has a handle. (1 point)
10. The others are all balls. (2 points)
    The bat is made of wood. (1 point)
11. You use the others to catch fish. (2 points)
    The fish goes in the water. (1 point)
12. The bell is not a musical instrument. (2 points)
    The bell makes noise -- goes on a bicycle. (1 point)

PART VI. PICTORIAL SIMILARITIES

The S receives two points for giving the abstract similarity. He receives one point for a concrete similarity and zero points for irrelevant concepts or differences. Examples of typical two and one point responses are listed below.

1. Can eat both -- both are sweets -- have sugar. (2 points)
   Both are candy. (1 point)
2. Toys -- play with. (2 points
   Baby things -- have arms, legs. (1 point)
3. Clothes -- wear both. (2 points)
   Put on. (1 point)
4. Drinks. (2 points)
   Both in glasses. (1 point)
5. Wheels -- tires. (2 points)
   Round -- run -- turn. (1 point)

6. Both fly. (2 points)
Both go in air -- have wings -- tails, etc. (1 point)
7. All fruit. (2 points)
Can be eaten -- have stems, seeds, etc. (1 point)
8. Animals -- found in zoo. (2 points)
Have tails, eyes, feet, etc. (1 point)
9. All write -- draw. (2 points)
Use in school -- round, long. (1 point)
10. All for baby's use. (2 points)
To wear. (1 point)
11. All sweet. (2 points)
Can be eaten. (1 point)
12. All give light. (2 points)
Burn -- all are lamps. (1 point)

PART VII. VERBAL DIFFERENCES

The S receives two points for any essential difference and one point for responses which constitute non-essential but actual differences or unexplained differences. The S receives zero points for similarities or irrelevant responses.

1. Kitten - Cat
Kitten is smaller than a cat -- Kitten is younger -- Kitten is a baby cat. (2 points)
Kittens come from cats. (1 point)
Both are animals -- Cats don't like kittens. (0 points)
2. Boat-Airplane
Boat goes in water, plane in the air. (2 points)
Airplane has wings. (1 point)
They run -- boat doesn't have a motor. (0 points)
3. Baby-Grandmother
Baby is younger than a grandmother. (2 points)
Baby is smaller than grandmother. (1 point)
Grandmother holds baby. (0 points)
4. King - Queen
King is a man -- King is higher in command than a Queen. (2 points)
They dress differently. (1 point)
The king is a ruler. (0 points)
5. Dress - Pants
Dress is worn by a girl. (2 points)
A dress doesn't go between your legs -- Pants are long. (1 point)
Wear them differently (unexplained). (0 points)
6. Sugar - Lemon
Lemons are sour, sugar is sweet. A lemon is a fruit, sugar isn't. (2 points)
They don't taste the same (unexplained) -- sugar is white and lemons are yellow. (1 point)
Sugar goes in coffee and lemons in tea. (0 points)
7. Tricycle - Bicycle
Bicycle has two wheels -- tricycle has three. (2 points)
Tricycles are for younger children. (1 point)
You ride them differently. (0 points)
8. Pond - River
A river is larger than a pond -- Rivers flow but ponds don't. (2 points)
A river has more fish. (1 point)
Ponds are bigger. (0 points)

9. Day - Night
In day it is light and night dark. (2 points)
You go to sleep at night, to school in day. (1 point)
They are different times. (0 points)

10. Rotten eggs - perfume
Rotten eggs stink and perfume smells good. (2 points)
You can wear perfume but not rotten eggs. (1 point)
You can eat eggs but not perfume. (0 points)

11. Drum - Harp
You beat a drum and pull on a harp. (2 points)
They make different sounds. (1 point)
Both beat. (0 points)

12. Butterfly - Moth
Butterfly has prettier colors than a moth -- Moths eat clothes. (2 points)
They hatch in different ways. (1 point)
A butterfly is bigger. (0 points)

13. Rock - Pillow
A rock is hard and a pillow is soft. (2 points)
Throw rocks, sleep on a pillow. (1 point)
You can throw a rock. (0 points)

14. Stove - Refrigerator
A stove keeps things hot and a refrigerator keeps them cold. (2 points)
A stove cooks, a refrigerator doesn't. (1 point)
You keep food in both. (0 points)

PART VIII. VERBAL SIMILARITIES

The S receives points for an essential similarity at an abstract level and one point for an essential similarity at a concrete level. The S receives zero points for irrelevant concepts and differences.

1. Basketball - Orange
Both are round. (2points)
Both are orange. (1 point)
You eat an orange -- bounce both. (0 points)

2. Television - Radio
Both have music -- Have news -- Both use electricity. (2 points)
Both run (unexplained) -- Have plugs. (1 point)
You listen to radio and watch TV. (0 points)

3. Window - Bottle
Both are glass. (2 points)
You can see through both -- Both will break. (1 point)
A window is square and a bottle round. (0 points)

4. Dime - Penny
Both are coins -- Money -- Spend both. (2 points)
Both are round -- Both have faces. (1 point)
A dime is smaller. (0 points)

5. Tractor - Mule
Both work -- Both on a farm -- Both pull things. (2 points)
Both move -- Both have energy. (1 point)
A tractor is stronger. (0 points)

6. Hat - Scarf
Wear both on your head. (2 points)
Both keep you warm. (1 point)
A scarf goes on your neck and a hat on your head. (0 points)

7.	Cow - Chicken	
	Animals	(2 points)
	Live on a farm -- have eyes, legs, etc.-- Get food from them.	(1 point)
	Cows give milk and chickens lay eggs.	(0 points)
8.	Necklace - Bracelet	
	Both are jewelry	(2 points)
	You can wear both -- Both have beads.	(1 point)
	You wear a bracelet on your arm and a necklace on your neck.	(0 points)
9.	Snow - Rain	
	Both fall from sky.	(2 points)
	Both are wet.	(1 point)
	Both are white.	(0 points)
10.	The number "1" - The Letter "A"	
	Both begin a system.	(2 points)
	They both start something.	(1 point)
	Write both in school.	(0 points)
11.	Ton - Mile	
	Both measures.	(2 points)
	Both large amounts -- Both have a lot.	(1 point)
	Both are heavy.	(0 points)
12.	Bugle - Saxophone	
	Both are musical instruments.	(2 points)
	Both make music -- Blow both -- Made of metal.	(1 point)
	A bugle is louder -- Both have strings.	(0 points)
13.	Shrimp - Oyster	
	Both are seafood -- Sea creatures.	(2 points)
	Both found in water -- Both are fish.	(1 point)
	A shrimp is larger than an oyster.	(0 points)
14.	Sister - Aunt	
	Both are female relatives.	(2 points)
	Both relatives -- Both girls -- Both people	(1 points)
	An aunt is older than a sister.	(0 points)

A Description of the Cognitive Flexibility Test Battery

Test 1: Stencil Design

Materials

The stencils used in this test were 16 circular cards that were cut from colored cardboard sheets. Each stencil had a radius of two inches. The colors were red, white, green and yellow. The basic design for each stencil was a symmetrical figure cut from the center of the card (see Figure 4). The stimulus figure for each item was a 5x3½ inch color print of the design. The demonstration item and items 1-3 required two stencils each; items 4-7, three stencils; items 8-11, four stencils; and item 12, five stencils. The following items were included in the final form of the test (see Figure 4 for the stencil number). Stencils 1-4 were solid cards of each color.

Demonstration. Stencils 2 and 5.

1. 4 and 10
2. 1 and 6
3. 4 and 15
4. 3, 8 and 12
5. 4, 15 and 8
6. 2, 8 and 12
7. 2, 16 and 14
8. 3, 13, 7 and 12
9. 2, 9, 6 and 9
10. 4, 14, 8 and 12
11. 4, 15, 10 and 6
12. 2, 10, 16, 6 and 9

Procedure

Demonstration Design. Spread the stencils for designs 1-3 in front of the subject and say, "__________, look here, I have some cards that have been cut out in different shapes (illustrate with the first four stencils); and now look here, I have some pictures of different designs. Each one of these designs can be made by putting together

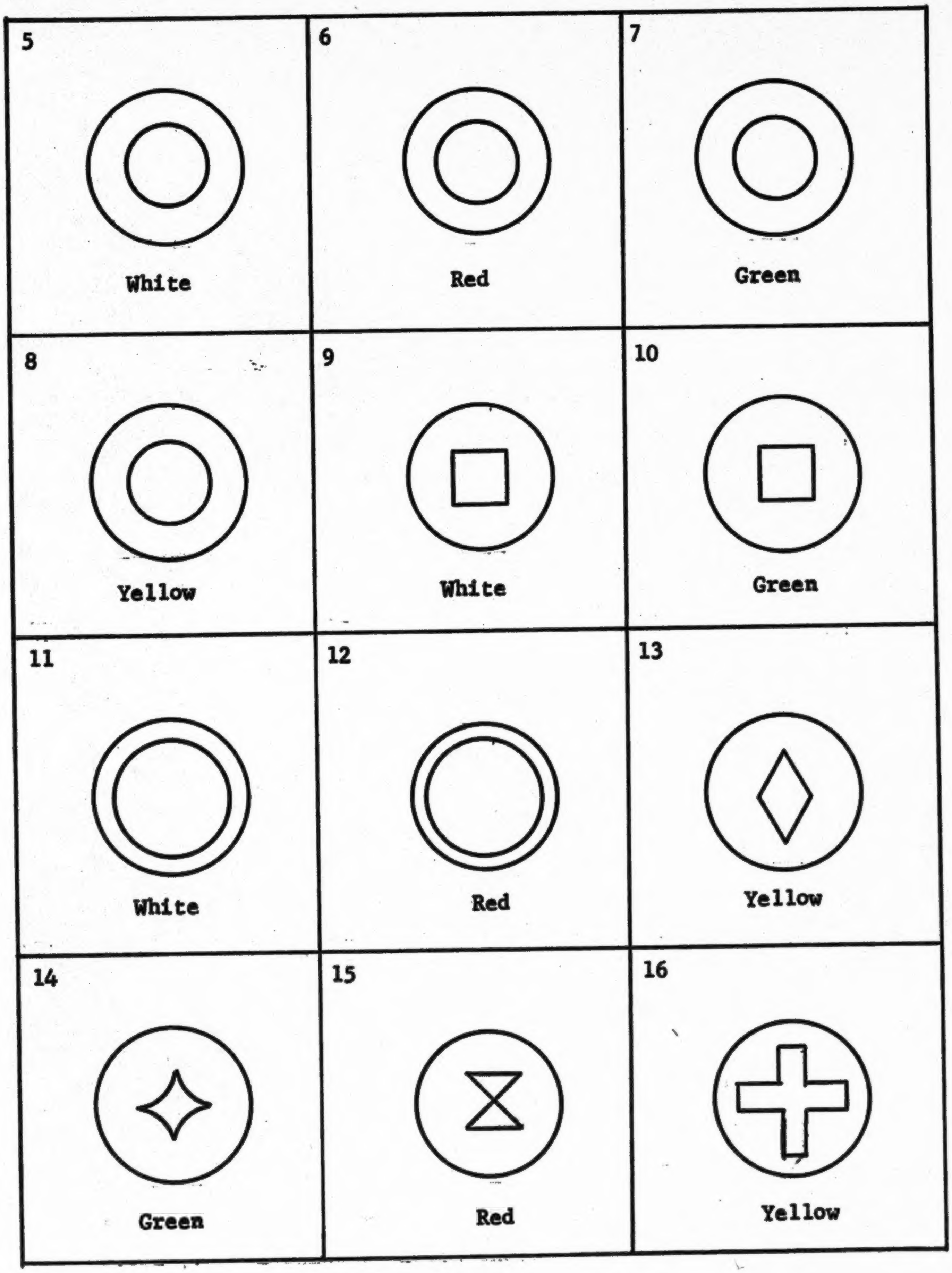

5
White
6
Red
7
Green
8
Yellow
9
White
10
Green
11
White
12
Red
13
Yellow
14
Green
15
Red
16
Yellow

Figure 4. The stencil design cards

the right cards in the right order. What I want you to do is to put the cards together to make a design that looks just like the one you see on each picture. Like this: See, if we put the red card on the bottom and the white card that has a circle cut out of it on the top, then we can make the design that's just like this. Now you try it. Make a design just like the one you see on this card."

If the subject fails, record the failure and correct him by saying, "That's not quite right. Watch me again." Then repeat the illustration, put the cards back in place, and say, "Now you do it; make one just exactly like this." If the subject fails the design the second time, continue the test with design 1.

Designs 1-2. "__________, this time I'm going to give you the picture of a design and see if you can put together the cards yourself. Make one just like this, using two of the cards you see here." If the subject fails the design, correct him as before and allow one more trial.

Designs 3-5. Place the required stencils for designs 3-5 in random order before the subject with the previously accumulated stencils. Say, "Now each time I'm going to give you a picture of a design, and I want you to make it from the cards you see here. Go ahead and tell me when you've finished." Repeat these directions for all other designs. Beginning with item 4, say, "Now make me one like this using three of the cards you see here." Allow two trials for designs D-2 with correction for failure on the first trial. Administer the first five designs to all subjects. Allow one minute for designs 1-3 and two minutes for designs 4-12.

Designs 6-7. Add the required stencils to those already before the subject and say, "Now make one like this using three of the cards you see here. Go ahead and tell me when you/ve finished."

Designs 8-11. Add the required stencils and say, "Now make one like this using four of the cards you see here."

Design 12. Say, "Now make one like this using five of the cards."

Scoring

On items 1-2 the subject receives two points for the correct reproduction on the first trial and one point for the second trial. All other items are scored either 2 or 0.

Test 2: Block Design

Materials

The materials used in this test were one set of nine, one-inch wooden cubes that were painted red and white, and 20 stimulus cards. The stimulus cards were four-inch square pieces of white cardboard on which the appropriate designs were drawn in color. Each stimulus figure was the same size as the actual design. The items are shown in Figure 5.

Procedure

Begin with item 3a for all subjects. If the subject fails any part of items 3a-4b, administer items 2a-1b until a criterion of two items without failure is reached. "See all of these blocks; they're just alike, aren't they - just the same? Two sides have been painted all red (illustrate), two sides have been painted all white, and two sides are painted half red and half white. If we use two of these blocks, we can make the design you see on this picture.

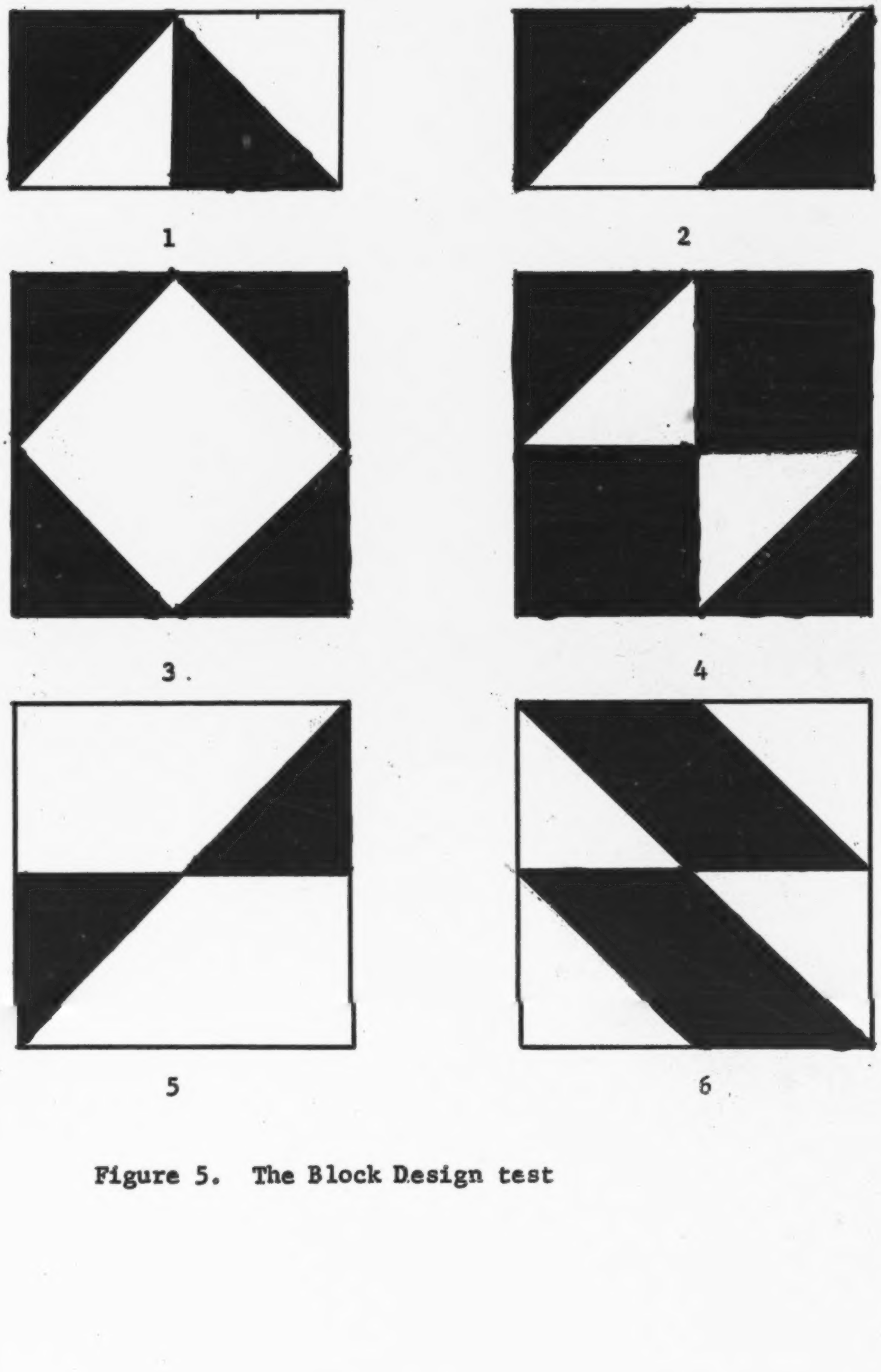
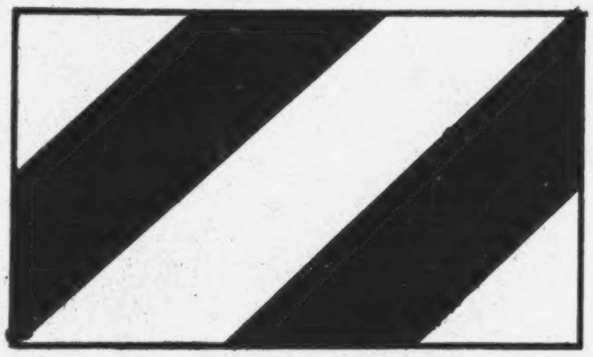

1 2 3 4 5 6

Figure 5. The Block Design test



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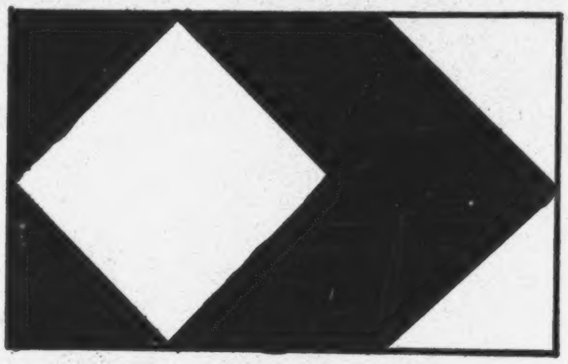

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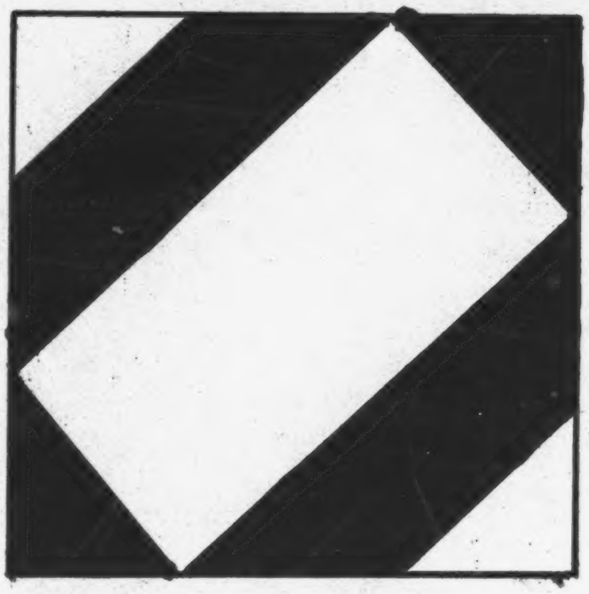

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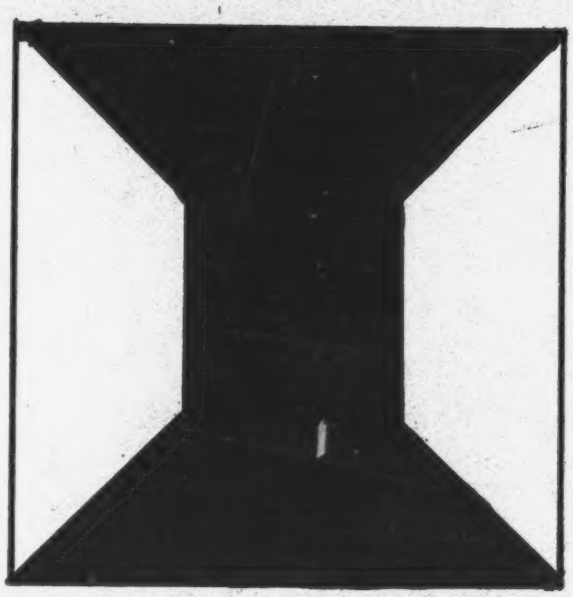

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Watch me first." Put together two blocks to make the demonstration item. "See how the design here looks just like the one on the picture? Now you do it. Make one just like this." If the subject fails the design, correct him by saying, "That's not quite right. See, it should look just like the picture. Watch me again." Reproduce the design correctly for the subject and indicate how it matches the picture. Then mix up the blocks and say, "Now you do it; make one just like this." If the subject fails the second trial, continue testing with item 1a.

Present item 1a and say, "Now let's make one just like this. Watch me first." Reproduce the design for the subject and illustrate how it matches the picture. Then mix up the blocks and say, "Now you do it; make one just like this using two blocks." If the subject fails the design, correct him as above and allow another trial. Continue testing with items 1b-5b using the same instructions as above and allowing two trials with correction for these items. When item 3a is reached, modify the directions by saying, "Now make one like this using four blocks." Allow two trials with correction for items 1a-3b. Administer these items to all subjects. If the subject fails items 2a-3b inclusively, discontinue testing. If the subject passes one or all of these items, continue testing until three consecutive items are failed. Beginning with item 4a, say, "Now make one like this." Allow only one trial per item. Allow one minute for items 1a-2b and two minutes for all other items.

Scoring

In general the subject is given one point for the correct reproduction of the first design in any item and one point for the second design of any item. He is given two points for shifting between designs. Thus, if the subject passes both item 1a and item 1b, he is given four points. On items 1-3 the subject is given one-half point if he fails the first trial and passes the second trial of any "a" or "b" parts of an item. However, if the subject passes a "b" part on the first trial after having failed an "a" part on the first trial and correctly reproduces the "a" part on the second trial, then he receives one point for the "b" part and one-half point for the "a" part. Thus, his total score for item 1 would be 1½ points.

Test 3: Picture Anomalies

Materials

The materials were 20 anomalies presented as incongruities in pictures either pasted or drawn on 5x8 inch index cards. The pictures used in the final form were the following:

1. Man wearing a baby's hat,
2. Dog with one ear,
3. Man riding a horse backwards,
4. Bicycle without a back wheel,
5. Cat wearing a hat,
6. Girl without a mouth,
7. Tree upside down in landscape scene,
8. Car with square wheels,
9. Woman pouring coffee in a broken cup,
10. Bird with one wing missing,
11. Mouse chasing a cat,
12. Girl reading a book upside down,
13. Mice drinking milk with a cat,
14. Fireman putting out brushfire instead of a house fire,
15. Clock with the numbers 2 and 4 interchanged,
16. Hunter walking past without seeing rabbit,
17. House with the roof upside down,
18. House with the door opened from the hinges,
19. Electric stove in the middle of a camp scene,
20. A plant with green flowers and red leaves.

Procedure

Present item 1 and say, "Now I'm going to show you some pictures in which something is wrong, and I want you to tell me what's wrong. What's wrong with this picture? What's not right?" If the subject responds correctly, say, "That's right. It's the hat. A grown man shouldn't be wearing a baby's hat, should he?" If the subject responds incorrectly or fails to respond, explain the absurdity to him, record the failure, and proceed to item 2. Repeat the same directions for each item. If the subject responds incorrectly to items 2 and 3, explain the absurdity. However, no explanation should be offered after item 3. Administer all the items. If the subject merely points to the anomaly, ask, "Why is that wrong?"

Scoring

The subject receives two points for each correct item.

Test 4: Embedded Figures

Materials

This test was composed of 10 items. Each item consisted of a large figure or object drawn on a 5x8 inch card with several parts represented on the same card. These items are shown in Figure 6.

Procedure

Present item 1 and say, "__________, see this big figure up here with the lines drawn across and down? (Illustrate.) This figure is made up of several parts or smaller figures. Here's one part here (point to small square). What I want you to do is to find a figure

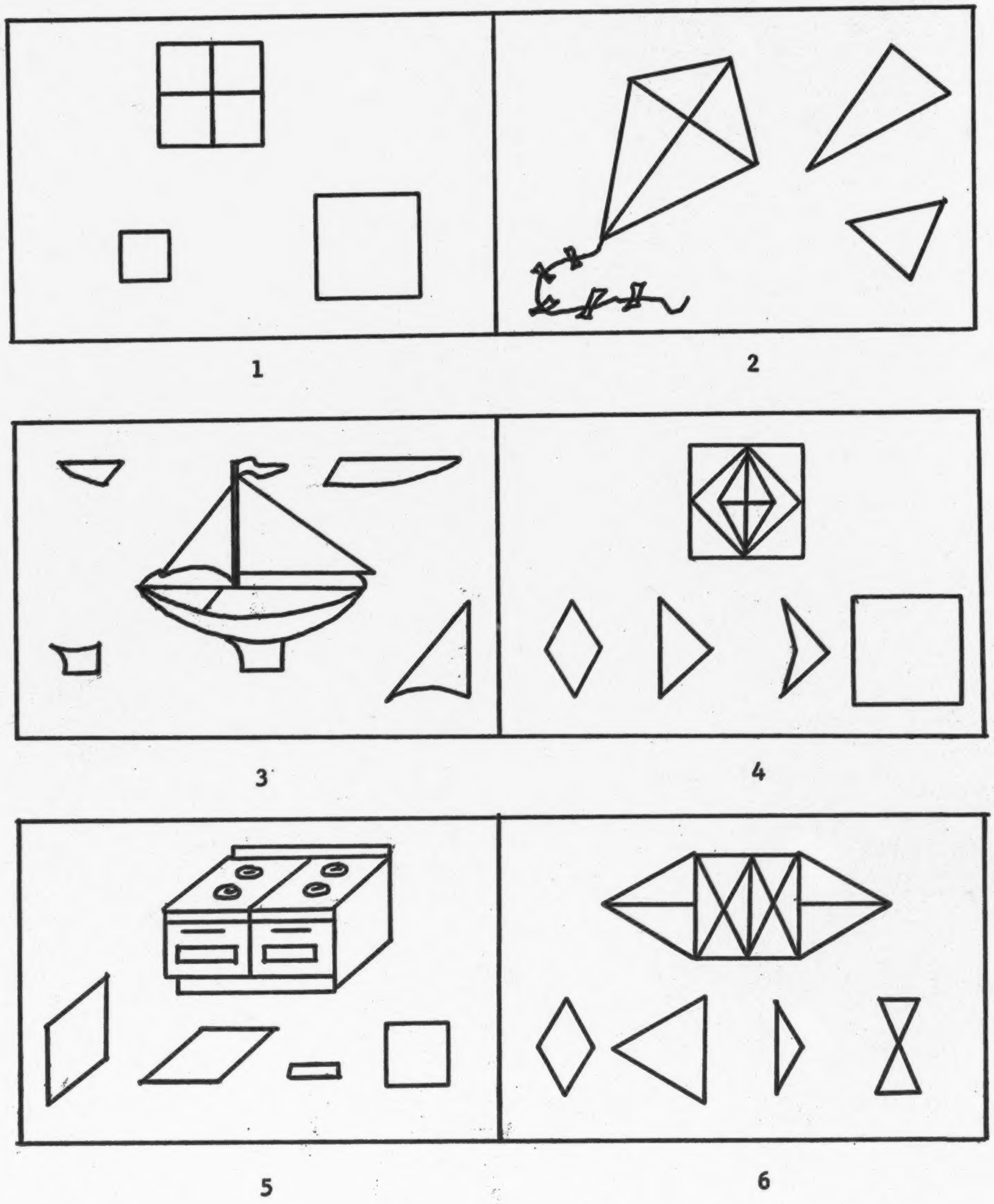
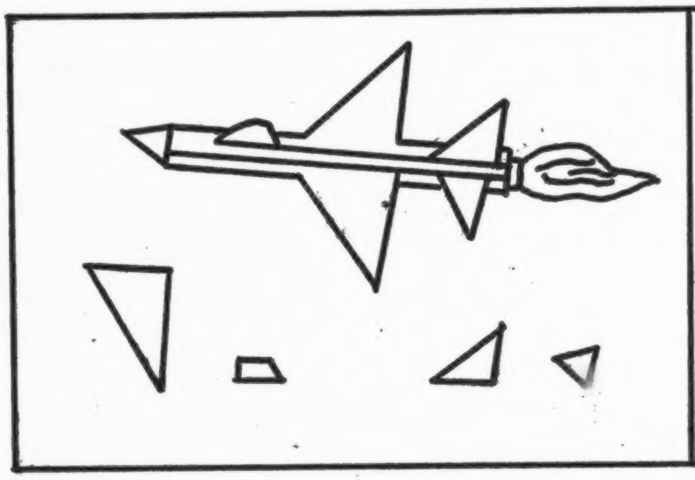


Figure 6. The Embedded Figures test



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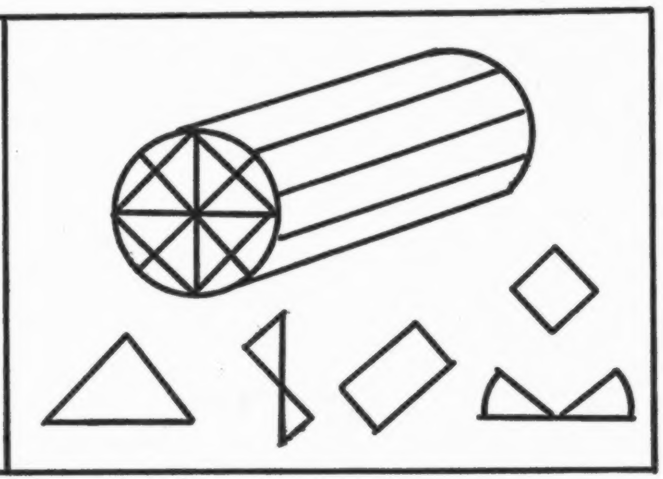

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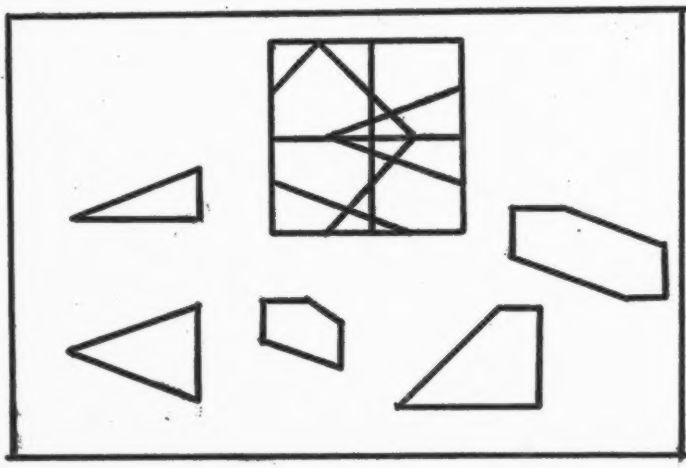

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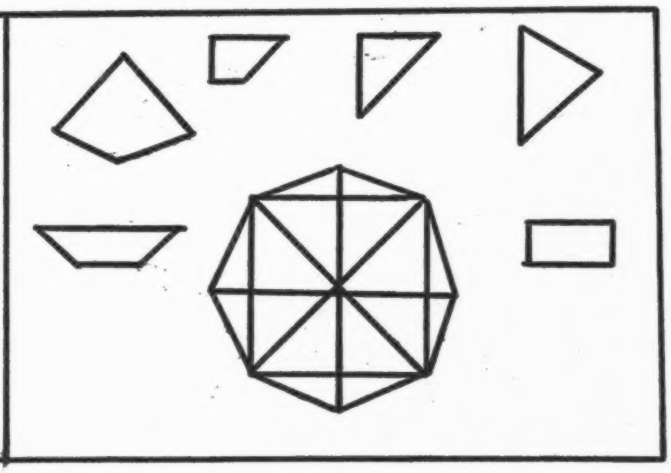

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just like this one up here in the big figure. After you've found it, go around the outside of it with your finger so I'll know you've found the right one." After the child has correctly located the smaller square, point out the other three squares and say, "Now find a figure just like this one up here in the big figure." If the subject fails to find either figure, point it out to him and repeat the instructions until he has located it. Repeat the same instructions for each item. Allow two trials for each figure of items 1-2; however, beginning with the third item, allow only one trial per figure for all remaining items. Administer all the items.

Scoring

Give one point for each figure correctly located. No points are given for figures located on the second trial of items 1-2.

Test 5: Similarities-Differences

Procedure

Pictorial. "Now I'm going to show you two things, and I want you to tell me how they are alike (the same) and how they are different."

1. Two red circles - one twice as large as the other. Give the child the card and say, "In what way are these alike or the same, and how are they different? That's right! They're both round (red), and one is bigger than the other." If the child fails to respond or names only a similarity or a difference, say, "Yes, but how are they alike (different)?" If the child fails after this prompting, record the failure and

proceed to the next item. Follow this procedure throughout the first five items.

2. Two squares - one blue and one green. Say, "How are these two things alike, and how are they different?" If the subject fails, prompt him as above.
3. Two triangles - one red and one green.
4. Rectangle and square - both blue.
5. Two hexagons - one with cross.

Verbal. "Now I'm going to name two things, and I want you to tell me how they are alike (the same) and how they are different. In what way are an orange and an apple alike, and how are they different?" If the subject names only a similarity or a difference, prompt him by saying, "In what way are they alike (different)?" This prompting procedure should be continued for items 6-8; however, it should not be employed after item 8. Administer the first eight items to all subjects. Discontinue after three failures.

6. Orange-Apple
7. Dime-Quarter
8. Car-Airplane
9. Knife-Spoon
10. Coffee-Milk
11. Stove-Refrigerator
12. Cow-Chicken
13. Table-Chair
14. Ring-Necklace
15. Snow-Rain

Scoring

In general the subject is given one point for a similarity and one point for a difference. He is given two points if he names both a similarity and a difference. Thus, there are four possible points for each item.

Test 6: Object Sorting

Materials

The materials for this test consisted of 47 wooden blocks that had been cut into different shapes and painted different colors. The first four items contained four blocks each, and the last three contained nine blocks each. A description of each item as well as the principles of sorting are listed below.

A. Demonstration item

1. Four round sticks - two red and two yellow
2. Color-size

B. Item 1

1. Two 1½ inch squares, two 1½ inch equilateral triangles - two red and two green
2. Color-shape

C. Item 2

1. Two three-inch long round sticks, two two-inch long - two blue and two red
2. Color-length

D. Item 3

1. Three-inch green square, 1½ inch yellow square, blue circle with 1½ inch radius, red circle with 3/4 inch radius
2. Shape-size

E. Item 4

1. Two round sticks, two squared sticks - two three-inch long and two two-inch long - all blue
2. Shape-length

F. Item 5
    1. Three squared objects, three rounded objects, three triangular objects - three thick, three thin and three long - red, blue and green
    2. Color, shape, size

G. Item 6
    1. Three triangles, circles and squares - green, blue and yellow - triangles, squares and crosses as context elements
    2. Color, shape, symbol, symbol color

H. Item 7
    1. Three crosses, three octagons and three squares - red, green and blue - triangles, squares and circles as context elements
    2. Color, shape, symbol, size

Procedure

Items D1 and D2. "__________, see these two sticks? They're just alike, aren't they - just the same? How are they alike? That's right; they're both red! They are also the same size and the same length, aren't they? Let's put them together here in the same pile because they are just alike." Show the subject the two yellow sticks. "Now look at these two. Are they alike? Are they the same? How are they alike? That's right; they are both yellow! They are also the same length and the same size, aren't they? Now you put them together in a pile over here because they are just alike. Now, __________, tell me how the red sticks in this pile are like the yellow sticks in this pile. That's right; they are the same size (length)." If the child fails to respond, explain the similarity. Mix up the sticks before the subject and repeat the demonstration by saying, "See, here we have four sticks. We can put the two red ones together in one pile because they are just alike, and we can put the two yellow ones in one pile because they are just alike. All four of the sticks are alike because they are the same size."

Spread the blocks for item 1 before the subject in a mixed-up order and say, "Now I'm going to give you four things, and I want you to put two of them that are alike in some way in one pile and the other two that are alike in another way in another pile. Watch me first." Put the two triangles in one pile and the two squares in another pile and say, "See, these two are alike because they both have three sides, and these two are alike because they both are square." Mix the blocks up again and say, "Now you do it. Put two that are alike in one pile and the other two that are alike in the other pile." After the child does this (help him if necessary), then say, "Now there is another way we can do it - there is another way that we can put two of these blocks that are alike in one pile and another way we can put the other two blocks that are alike in another pile that's different from the way we have them here. See, we can put the two red blocks together because they are alike - they're both red - and we can put the two green blocks together because they are alike - they're both green." Mix the blocks up and say, "Now you do it. Put the blocks together a different way from the way you did it the first time." Mix the blocks up and have the subject sort them two different ways without help. After the subject does this, say, "You see, there are two different ways to do it." If he fails to shift properly, repeat the demonstration as above, pointing out both sorting principles. Give no further help after this item.

Items 2-4. Present each item in a mixed-up order before the subject and say, "Put two of these blocks that are alike in some way in one pile and the other two that are alike in another way in another pile." After the subject has sorted on one principle (correct or incorrect), say, "Now do it another way. Put two of these blocks that are alike in one pile and two that are alike in the other pile; but do it in another way that's different from the way you have them here."

Items 5-7. Present each of the items with the same instructions as above; however, repeat the instructions for shifting after the second sorting in order to elicit a third sorting. Beginning with item 5, say, "Now I'm going to give you nine blocks, and I want you to put them together in three piles so that three blocks in each pile are alike." Elicit a fourth sorting in items 6 and 7 as given above.

Scoring

In general the subject receives one point for each correct concept and additional points on a progressive scale for each shift performed. Two points are given for the first shift, three for the second, and four for the third. Thus, if the subject correctly sorts on two correct principles for item 2, he would receive one point for each concept and two points for the shift between them, or a total of four points. If the subject correctly sorts on four principles for item 7, then he would receive a total of 13 points. However, if he only sorts on three principles, he would receive only eight points.

Test 7: Card Sorting

Materials

The test was composed of 12 sets of four, 3x4 inch cards on which the pictures of various objects were pasted. Each set of cards could be sorted into two categories according to two different principles. The items that were selected for the final form were the following:

1. Red rectangle, yellow flower, red flower, yellow rectangle,
2. Dog, barn, dog house, cow,
3. Three baseballs, two blocks, two baseballs, three blocks,
4. Cat, kitten, chicken, chick,
5. Dog with ball, boy eating, dog eating, boy with ball,
6. Two boys, girl writing, boy drawing, two girls,
7. Pants, girl, skirt, boy,
8. Lamp, candleholder, light bulb, candle,
9. Car, motorboat, bicycle, sailboat,
10. Head, gloves, hat, hand,
11. House, boy writing on blackboard, girl washing dishes, school,
12. Boy sawing, nails, board, hammer.

Procedure

Hand the subject the first four cards in the prescribed order and say, "__________, see all of these four cards have pictures on them. Put two of them that are alike in one pile and the other two that are alike in another pile." If the subject fails to sort on one principle correctly, explain the sorting principle to him and demonstrate the correct arrangement. Then say, "Now you do it." (Repeat the instructions as given above.) After the subject has correctly sorted on one principle, say, "Good, now do it another way. Put them together in a way that is different from the way you have them here, so that two of the cards in one pile are alike and the other two in the other pile are alike." If the subject fails to sort on the second principle or perseverates, explain the second principle and demonstrate the correct sorting. After the demonstration, elicit the subject's independent sorting on both principles using the instructions given above. Allow two trials per concept for this item only.

Present all other items by handing the subject the four cards and saying, "Put two of these that are alike in one pile and the other two that are alike in another pile." After the first sorting, say, "Now do it another way. Put them together in a different way so that two of the cards in each pile are alike in some way that's different from the way you put them together the first time."

Scoring

For each item give one point for each correct concept and two points for shifting concepts. Thus, there are four possible points for each item.

Test 8: Word Naming

Procedure

Say, "Now I want to see how many different words you can say in one minute. Any words you think of will do, like table, sky, happy, run, horse. O.K., when I say 'go,' you say the words as fast as you can, and I will count them. Remember, you can't say the same word twice. They must be different. O.K., go."

Scoring

The score is the number of different words named in one minute. Perseverative responses are not counted.

Test 9: Tell About This

Procedure

Hand the subject the green block and say, "Tell me all about this." If the subject does not respond or omits one of the following categories of response, prompt him by saying, "What is it? What is it made of? What color is it? What do you use it for?" If the subject fails to answer any one of these questions, supply answers for him, e.g., "It's a block, isn't it? It's green; it's made of wood; and you use it to build things, don't you?" Use these questions for the demonstration item only. Thereafter, hand each object to the subject and say, "Tell me all about this." If the subject fails to respond during any 15-second period after the last response, go to the next item. Allow one minute for each item. The items used were the following:

1. Rubber ball,
2. Plactic cup,
3. Nail,
4. Button,
5. Small box.

Scoring

The score for each item is the number of characteristics named in one minute. These can be in the categories of name, color, shape, composition, use, or related physical characteristics.

The Cognitive Flexibility Test Battery

PART I. STENCIL DESIGN

Instructions

Demonstration Designs. Spread the stencils for designs D1-2 in front of the subject and say: "__________, look here, I have some cards that have been cut out in different shapes (illustrate with the first four stencils); and now look here, I have some pictures of different designs. Each one of these designs can be made by putting together the right cards in the right order. What I want you to do is to put the cards together to make a design that looks just like the one you see on each picture. Like this: See, if we put the red card on the bottom and the white card that has a circle cut out of it on the top, then we can make the design that's just like this. Now you try it. Make a design just like the one you see on this card."

If the subject fails, record the failure and correct him by saying, "That's not quite right. Watch me again." Then repeat the illustration, put the cards back in place, and say: "Now you do it, make one just exactly like this." If the subject fails the design the second time, continue the test with design 1.

Designs 1-2. "__________, this time I'm going to give you the picture of a design and see if you can put together the cards yourself. MAKE ONE JUST LIKE THIS, USING TWO OF THE CARDS YOU SEE HERE." If the subject fails the design, correct him as before and allow one more trial.

Designs 3-5. Place the required stencils for designs 3-5 in random order before the subject with the previously accumulated stencils. Say: "Now each time I'm going to give you a picture of a design, and I want you to make it from the cards you see here. Go ahead and tell me when you've finished." Repeat these directions for all other designs.' Beginning with item 4, say: NOW MAKE ME ONE LIKE THIS USING THREE OF THE CARDS YOU SEE HERE." Allow two trials for designs D-2 with correction for failure on the first trial. Administer the first three designs to all subjects. Allow one minute for designs 1-3 and two minutes for designs 4-12. Discontinue after three consecutive failures.

Designs 6-7. Add the required stencils to those already before the subject and say: "NOW MAKE ONE LIKE THIS USING THREE OF THE CARDS YOU SEE HERE. GO AHEAD AND TELL ME WHEN YOU'VE FINISHED."

Designs 8-10. Add the required stencils and say: "NOW MAKE ONE LIKE THIS USING FOUR OF THE CARDS YOU SEE HERE."

Scoring

All items are scored either 1 or 0.

PART II. EMBEDDED FIGURES

Instructions

Present item D1 and say: "__________, see this big figure up here with the lines drawn across and down? (Illustrate.) This figure is made up of several parts or smaller figures. Here's one part here (point to small square). What I want you to do is to find a figure just like this one up here in the big figure. After you've found it, go around the outside of it with your finger so I'll know you've found the right one." After the child has correctly located the smaller square, point out the other three squares and say: NOW FIND A FIGURE JUST LIKE THIS ONE UP HERE IN THE BIG FIGURE." If the subject fails to find eit figure, point it out to him and repeat the instructions until he has located it. Repeat the same instructions for each item. Allow two trials for each figure of item D1-D2; however, beginning with the third item, allow only one trial per figure for all remaining items. Administer all the items.

Scoring

Give one point for each figure correctly located. Do not score the demonstration items.

PART III. PICTURE ANOMALIES

Instructions

Present item D1 and say: "Now I'm going to show you some pictures in which something is wrong, and I want you to tell me what's wrong. WHAT"S WRONG WITH THIS PICTURE? WHAT"S NOT RIGHT?" If the subject responds correctly, say: "That's right. It's the wing. Part of the bird's wing has been left off, hasn't it." If the subject responds incorrectly or fails to respond, explain the absurdity to him, record the failure, and proceed to item D2. Repeat the same directions for each item. If the subject responds incorrectly to item D1 or D2, explain the absurdity. However, no explanation should be offered after item D2. Administer all the items. If the subject merely points to the anomaly, ask, "Why is that wrong?" Discontinue three consecutive failures.

Scoring

The subject receives one point for each correct item.

PART IV. OBJECT SORTING

Instructions

Items D1 and D2. "__________, see these two sticks? They're just alike, aren't they - just the same? How are they alike? That's right; they're both red! They are also the same size and the same length, aren't they? Let's put them together here in the same pile because they are just alike." Show the subject the two yellow sticks. "Now look at these two. Are they alike? Are they the same? How are they alike? That's right; they are both yellow! They are also the same length and the same size, aren't they? Now you put them together in a pile over here because they are just alike. Now, __________, tell me how the red sticks in this pile are like the yellow sticks in this pile. That's right; they are the same size (length)." If the child fails to respond, explain the similarity. Mix up the sticks before the subject and repeat the demonstration by saying: "See, here we have four sticks. We can put the two red ones together in one pile because they are just alike, and we can put the two yellow ones in one pile because they are just alike. All four of the sticks are alike because they are the same size."

Spread the blocks for item D2 before the subject in a mixed-up order and say, "See, these two are alike because they both have three sides, and these two are alike because they both are square." Mix the blocks up again and say: "Now you do it. Put two that are alike in one pile and the other two that are alike in the other pile." After the child does this (help him if necessary), then say: "Now there is another way we can do it - there is another that we can put two of these blocks that are alike in another pile that's different from the way we have them here. See, we can put the two red blocks together because they are alike - they're both red - and we can put the two green blocks together because they are alike - they're both green." Mix the blocks up and say, "Now you do it. Put the blocks together a different way from the way you did it the first time." Mix the blocks up and have the subject sort them two different ways without help. After the subject does this, say: "You see, there are two different ways to do it." If he fails to shift properly, repeat the demonstration as above, pointing out both sorting principles. Give no further help after this item.

Items 1-3. Present each item in a mixed-up order before the subject and say: "PUT TWO OF THESE BLOCKS THAT ARE ALIKE IN SOME WAY IN ONE PILE AND THE OTHER TWO THAT ARE ALIKE IN ANOTHER WAY IN ANOTHER PILE." After the subject has sorted on one principle (correct or incorrect), say: "NOW DO IT ANOTHER WAY. PUT TWO OF THESE BLOCKS THAT ARE ALIKE IN ONE PILE AND TWO THAT ARE ALIKE IN THE OTHER PILE; BUT DO IT IN ANOTHER WAY THAT'S DIFFERENT FROM THE WAY YOU HAVE THEM HERE."

Items 4-6. Present each of the items with the same instructions as above; however, repeat the instructions for shifting after the second sorting in order to elicit a third sorting. Beginning with item 4, say, "NOW I'M GOING TO GIVE YOU NINE BLOCKS, AND I WANT YOU TO PUT THEM TOGETHER IN THREE PILES SO THAT THREE BLOCKS IN EACH PILE ARE ALIKE." Elicit a fourth sorting in items 5 and 6 as given above. On items 4-6 discontinue if S fails two consecutive parts.

Scoring

In general the subject receives one point for each correct concept and additional points on a progressive scale for each shift performed. Two points are given for the first shift, three for the second, and four for the third. Thus, if the subject correctly sorts on two correct principles for item 2, he would receive one point for each concept and two points for the shift between them, or a total of four points. If the subject correctly sorts on four principles for item 6, then he would receive a total of 13 points. However, if he only sorts on three principles, he would receive only eight points.

PART V. TELL ABOUT THIS

Instructions

Hand the subject the green block and say: "TELL ME ALL ABOUT THIS." If the subject does not respond or omits one of the following categories of response, prompt him by saying, "What is it? What is it made of? What color is it? What do you use it for?" If the subject fails to answer any one of these questions, supply answers for him, *e.g.*, "It's a block, isn't it? It's green; it's made of wood; and you use it to build things, don't you?" Use these questions for the demonstration item only. Thereafter, hand each object to the subject and say: "TELL ME ALL ABOUT THIS." If the subject fails to respond during any 15-second period after the last response, go to the next item. Allow one minute for each item. The items used were the following:

1. Plastic cup
2. Nail
3. Button
4. Small box

Scoring

The score for each item is the number of characteristics named in one minute. These can be in the categories of name, color, shape, composition, use, or related physical characteristics.

THE PRODUCTIVITY-RESPONSIVENESS TEST: INSTRUCTIONS FOR ADMINISTRATION, DESCRIPTION OF THE ITEMS, AND SCORING STANDARDS

Part I. Sorting

This test consists of 75 white and 75 red poker chips, and a 4 x 8 inch box divided into two compartments. The task is to put as many red chips in one side, and as many white chips in the other, as possible within one minute.

Part II. Pressing

This test uses a hand counter pressed with the thumb with a dial recording the number of presses.

Part III. Form Board

Two form boards - 20 x 12 inches with 36 round holes in each and 36 two-inch round blocks to be inserted. The task is to transfer blocks from one board to the other.

Part IV. Circle Construction

Eighteen circles on the Record Form are used here. The task is to change the circles by drawing into each an object of some sort.

Part V. Tell About This

A toy plastic cup, a nail, a button, and a box are the objects employed. The task is to describe qualities of the objects.

Part VI. Tell About Pictures

Four pictures, a mother knitting in a living room, a Western farm scene, a dinner scene, and a circus scene, are presented. The task is to enumerate, describe or abstract these pictures.

Part VII. Toy Changes

Two objects, a toy wood boat used as demonstration item, and a solid wood car, are employed. The task is to suggest improvements in the car.

Part VIII. Word Naming

The task here is the number of words named within a time limit.

The Productivity-Responsiveness Test

PART I. SORTING

Instructions

"Now I want to see how fast you can work with your hands. See, the red chips go in this box and the white chips go in this box. When I say go, put as many chips as you can in each box using just one hand. Go ahead and put one in each box just for practice. Remember the red ones go in this box and the white ones go in this box. Keep working as fast as you can until I say stop. O.K. Go!" After 15 seconds say, "Go as fast as you can."

THE TIME LIMIT IS ONE MINUTE.

Scoring

The score is the number of chips placed in each box in one minute. Deduct errors in sorting from the total.

PART II. PRESSING

Instructions

"O.K., now I want to see how many times you can press this button like this (demonstrate). When I say 'Go' press it as fast as you can until I say 'Stop'." After 10 seconds, say, "Go as fast as you can."

Scoring

The number of presses in 30 seconds.

PART III. FORM BOARD

Instructions

First determine whether the child is right handed or left handed. Then place the board so that the empty side is opposite the preferred hand and with the small end toward S. "This time see how fast you can put these round blocks back in their holes. See, they go like this (demonstrate). Go ahead and do a few for practice (allow S to place 5 blocks). "When I say 'Go', put as many of these blocks in their holes as you can. Pick up just one block each time. O.K., Go."

TIME LIMIT IS 30 SECONDS.

Scoring

The number of blocks placed in 30 seconds.

PART IV. CIRCLE CONSTRUCTION

Instructions

"______ you know a lot of different things are made from circles. For example, a tire is made from a circle, see (demonstrate by drawing a tire for S in first circle). See how many different things you can make from these circles. Go ahead and draw them in. Use one circle for each thing you think of."

If S's drawing is ambiguous, question him. If S does not understand the instructions, repeat them using a plate as an example. Encourage any type of response; however, if S gets off the track remind him that his drawings should be of things made from circles. Encourage him by saying, "Try to think of something else thats round like a circle."

TIME LIMIT IS THREE MINUTES. Discontinue after 45 seconds of no response.

Scoring

In general the score is the number of different drawings within the time limit. Credit is given for the idea expressed rather than the accuracy of the drawing. Nevertheless, S must make some effort to draw the object however crude. In other words, S cannot receive credit for merely naming round objects. Also credit is given only for objects containing circular properties.

PART V. TELL ABOUT THIS (See CF test battery)

PART VI. TELL ABOUT PICTURES

Instructions

"_______ look at this picture and tell me all about it. What do you see in this picture. Tell me as many different things about this picture as you can." Prompt S if necessary by saying, "Tell me some more."

TIME LIMIT IS ONE MINUTE FOR EACH PICTURE.

Scoring

Each response is scored according to any one or any combination of the following categories of response: enumeration, description, interpretation or abstraction. S receives a maximum of three points for the enumeration of three or more objects in the picture and one point for a response in each of the other three categories. Thus, there are six possible points for each card. If S gives an interpretation or general abstraction, he is automatically awarded three points for enumeration. For example, see the scoring criteria.

PART VII. TOY CHANGES

Instructions

"_______ you know that sometimes you can make things better if you change them in some way. I have here several toys and I want you to tell me how you would change them to make them better or more fun to play with. Any way you thi of is O.K. For example, several children have said they would change this boat by putting a motor in it. Others have said they would make it stronger by building it from steel. How would you change it?" Elicit several responses then present the test item. There is no time limit; however, discontinue after 45 seconds of no response. Introduce the test item by saying, "How would you change this car?" Prompt S by saying, "Think of another way you could change it."

Scoring

The score is the number of changes mentioned. Changes must be relevant to the test object, e.g., "I would put a sail on it so it could float," receives no credit.

PART VIII. WORD NAMING

Instructions

"Now I want to see how many words you can name in one minute. Just any words you think of will do, like 'house', 'ship', 'cloud'. When I say 'Go' begin and say the words as fast as you can and I will count them. O.K., Go."

TIME LIMIT IS ONE MINUTE.

Scoring

The number of words named in one minute.

The Productivity-Responsiveness Test

PART VI. TELL ABOUT PICTURES

The categories of scoring are: enumeration, the naming of specific objects in the picture; description, responses relating objects to objects by animate or inanimate action, e.g., the lamp sitting on the table; interpretation, responses indicating the projection of an implied relationship between the objects of the picture, e.g., the mother doesn't know the cat is there; abstraction, responses which organize the entire picture under one concept, e.g., it's a fair.

S receives a maximum of three points for the enumeration of three or more objects in the picture and one point for a response in each of the other three categories. Thus, there are six possible points for each card. If S gives an interpretation or general abstraction, he is automatically awarded three points for enumeration.

1. Knitting

Enumeration

It's a room with a woman and her little girl. (2 points)
There is a cat. (1 point)

Description

There is a lamp on the table behind the woman. (1 point)
The girl is in the door. (1 point)
The woman is knitting. (1 point)
The girl is eating. (1 point)

Interpretation

The mother doesn't see the girl. (1 point)
She doesn't know the cat is unwinding her sweater. (1 point)
The girl is slipping by the door so her mother won't see her. (1 poi

Abstraction

It's a family. (1 point)
The girl is getting away with taking the cookies. (1 point)
The mother doesn't know what they're doing. (1 point)

Combinations of categories

The mother is sitting in her chair knitting and isn't paying attention to the cat. (1 point for description + 1 point for abstraction + 3 points for enumeration = 5 points)

The girl is trying to go through the door without her mother seeing her. (1 point for description + 1 point for interpretation + 3 points for enumeration = 5 points)

The cat is playing with the string and it's wrapped around his tail. (1 point for description + 2 for enumeration = 3 points)

The little girl has pigtails ... she's eating. (1 point for description + 2 points for enumeration = 3 points)

The mother is mad because the girl is late for school. (1 point for interpretation + 3 points for enumeration = 4 points)

2. Cowboy

Enumeration

There is a barn ... a house (etc.) (1 point each)

Description

They are watching him ride. (1 point)
He's walking across the road. (1 point)
They're putting hay in the barn. (1 point)
They're sitting on the fence. (1 point)

Interpretation

He's breaking in the horse. (1 point)
They have stopped work to watch him. (1 point)
The horse is trying to throw him off. (1 point)

Abstraction

They're all working on a ranch. (1 point)
They're out west. (1 point)

Combinations of categories

They're out west putting in hay for the winter. (1 point for abstraction + 1 point for interpretation + 3 points for enumeration = 5 points)

The sun is going down and they are about to quit work. (1 point for description + 1 point for interpretation + 3 points for enumeration = 5 points)

There is a barn ... the men are watching the cowboy. (2 points for description + 3 points for enumeration = 5 points)

3. Dinner

Enumeration

A man, woman, children (etc.) ... dinner table. (1 point each)

Description

They're sitting at the dinner table. (1 point)
The mother is putting a dish on the table. (1 point)
The dog is under the table. (1 point)

Interpretation

The parents don't see that they are feeding the dog. (1 point)

The children aren't hungry so they are giving their food to the dog. (1 point)

The dog doesn't know which piece to take. (1 point)

Abstraction

It's a family sitting at the dinner table. (1 point)

Combinations of categories

The family is eating dinner and the children are feeding the dog. (1 point for abstraction + 1 point for description + 3 points for enumeration = 5 points)

The mother is putting food on the table and the children are giving it to the dog. (2 points for description + 3 points for enumeration = 5 points)

The father is mad because he caught them feeding the dog. (1 point for interpretation + 3 points for enumeration = 4 points)

4. Circus

Enumeration

There is a clown, a fat lady, some balloons and children (3 points)
There's a tend and some other things. (1 point)

Description

The man is holding seven balloons. (1 point)

The tent has a fat lady in it and the clown is throwing striped balls. (1 point)

The clown has a polka-dotted shirt. (1 point)

Interpretation

The little girl just bought a ticket and is going in the tent.(1 poir
She is buying a balloon. (1 point)
The clown looks sad. (1 point)

Abstraction

It's a circus. (1 point)
They're seeing a show. (1 point)

Combination of categories

The boy and girl are trying to decide whether or not to see the show. (1 point for interpretation + 1 point for abstraction + 3 points for enumeration = 5 points)

The children are all going to the circus. (1 point for abstraction + 3 points for enumeration = 4 points)

The clown is throwing the balls up and down and the two girls are watching him. (1 point for description + 3 points for enumeration = 4 points)

The clown is in front of the tent... There is a man with balloons. (1 point for description + 3 points for enumeration = 4 points)

The Cognitive Training Experimental Test Battery Record Form

Subject ________________ Sex ________ Date ________________

School ________________ Group ________ Birthdate ________________

Teacher ________________ Examiner ________________ CA ________________

Test Summary

The Similarities-Differences Test

Part	Weight	Raw Score	Weighted Score	Standard Score
I. Colored Forms				
II. Forms				
III. Animals				
IV. Abstract Forms				
V. Pictorial Differences				
VI. Pictorial Similarities				
VII. Verbal Differences				
VIII. Verbal Similarities				
SD Total				

The Cognitive Flexibility Test

I. Stencil Design	10			
II. Embedded Figures	1			
III. Picture Anomalies	10			
IV. Object Sorting	5			
V. Tell About This	1			
CF Total				

The Productivity-Responsiveness Test

I. Sorting				
II. Pressing				
III. Form Board				
IV. Circle Construction				
V. Tell About This				
VI. Tell About Pictures				
VII. Toy Changes				
PR Total				

Introduction: I'm going to ask some questions and give you some puzzles to work to see how you compare with others your age. We will begin by looking at some cards and I'll ask you some questions about them. Then we'll work several different kinds of puzzles. O.K., let's start with these.

The Similarities-Differences Test

Part I. Colored Forms
Score 2, 1 or 0.

D1
D2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
TOTAL

Part II. Forms
Score 2 or 0.

1
2
3
4
5
6
D1
D2
7
8
9
10
11
12
13
14
15
16
TOTAL

Part III. Animals
Score 2 or 0.

1
2
3
4
5
D1
D2
D3
6
7
8
9
10
11
12
13
TOTAL

Part IV. Abstract
Forms-Score 2 or

1
2
3
4
5
6
7
8
TOTAL

Part V. Pictorial Differences
Score 2, 1 or 0. Discontinue 3 failures.

Response	Score	Response	Score
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

TOTAL

Part VI. Pictorial Similarities
Score 2, 1 or 0. Discontinue 3 failures.

	Response	Score
D1		
D2		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
TOTAL		

Part VII. Verbal Differences
In what way are a _____ and a _____ different? Score 2, 1 or 0. Discontinue 3 failures.

	Response	Score
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
TOTAL		

Part VIII. Verbal Similarities
In what way are a _____ and a _____ alike or the same? Score 2, 1 or 0. Discontinue 3 failures.

	Response	Score
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
TOTAL		

The Cognitive-Flexibility Test

Part I. Stencil Design

Score 1 or 0. Discontinue 3 failures.

D1a b
(1 min)
1
2
3*
(2 min)
4
5
6*
7
8*
9
10
TOTAL ______

Part II. Embedded Figures

Score 1 or 0. Administer all items.

D1a ___ b___
D2a ___ b___
1a ___ b___ c___ d___
2a ___ b___ c___ d___
3a ___ b___ c___ d___
4a ___ b___ c___ d___
5a ___ b___ c___ d___
6a ___ b___ c___ d___ e___
7a ___ b___ c___ d___ e___
TOTAL ______

Part III. Picture Anomalies

Score 1 or 0. Discontinue 3 failures.

Response	Score
D1	
D2	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

TOTAL ______

Part IV. Object Sorting

Put two of these blocks that are alike in some way in one pile and the other two that are alike in another way in another pile. Now do it another way. Put two that are alike in one pile and two that are alike in the other pile; but do it in another way that's different from the way you have them here. Administer all the items. On items 4-6 discontinue if S fails two consecutive parts. Score 0, 1, 4, 8, or 13.

D1. color______ size______
D2. color______ shape______
1. color______ length______
2. shape______ size______
3. shape______ length______
4. color______ shape______ size______
5. color______ shape______ symbol______ symbol color______
6. color______ shape______ symbol______ size______

E-44 TOTAL ______

Part V. Tell About This

Tell me all about this. One minute each item. Discontinue if no response after 15 seconds.

1. Cup	Name________ Color________ Drink________ Handle________	Round________ Tea________ Coffee________ Pour________
2. Nail	Name________ Color________ Build________ Sharp________	Point________ Head________ Tool________ Hammer________
3. Button	Name________ Color________ Sew________ Round________	Holes________ Wear________ Shirt________ Dress________
4. Box	Name________ Color________ Square________ Put in________	Edges________ Holds Things________ Carry Things________ Four Sides________

TOTAL

The Productivity-Responsiveness Test

Part I. Sorting

Now I want to see how fast you can work with your hands. See, the red chips go in this box and the white chips go in this box. When I say, 'Go' put as many chips as you can in each box. Keep working as fast as you can. Use just one hand. Time: one minute. Score number of chips in each box.

____

Part II. Pressing

Now I want to see how many times you can press this button, like this. When I say 'Go' press it as fast as you can until I say 'Stop'. After 10 seconds, say, 'Go as fast as you can'. Time 30 seconds. Score is number of presses.

____

Part III. Form Board

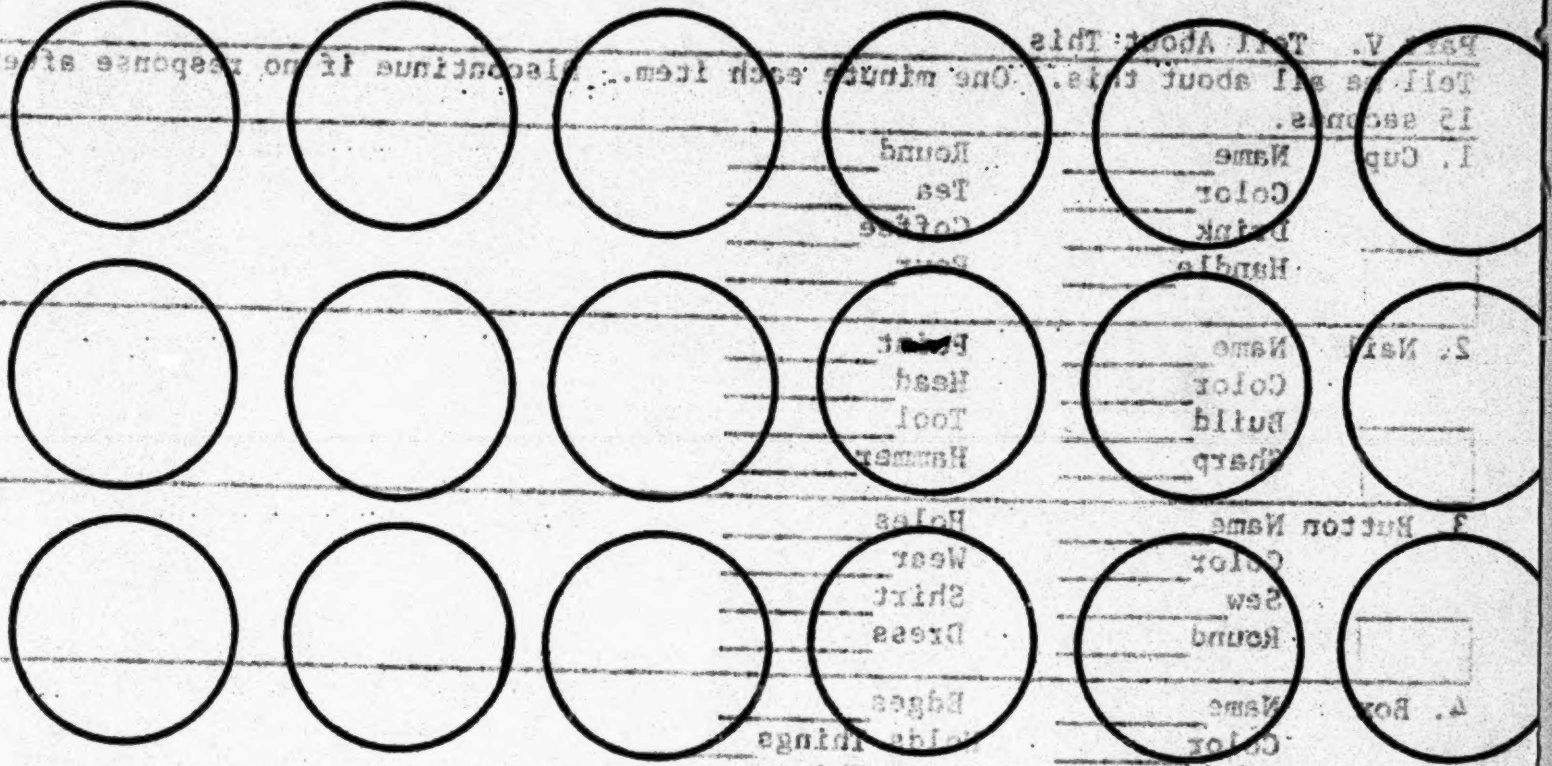
This time I want to see how fast you can put these round blocks in their holes. See they go in like this. When I say 'Go' put as many of these blocks in their holes as you can. Pick up just one block each time. Time 30 seconds. Score number placed.

____

Part IV. Circle Construction

You know a lot of different things are made from circles. For example, a tire is made from a circle, see (demonstrate). See how many different things you can make from these circles. Go ahead and draw them in. Use one circle for each thing you think of. Try to think of something else that's round like a circle. Time 3 minutes. Discontinue after 45 seconds of no response. Score is the number of things drawn.

____



Part V. Tell About This (Score from CF Battery)

Part VI. Tell About Pictures

Look at this picture and tell me all about it. What do you see in this picture. Tell me as many different things about this picture as you can. (Tell me more) Score later using scoring criteria. Time one minute for each item.

1.

2.

3.

4.

TOTAL

Part VII. Toy Changes

You know that sometimes you can make things better if you change them in some way. I have here several toys and I want you to tell me how you would change them to make them better or more fun to play with. Any way you think of is O. K. For example, several children have said they would change this airplane by putting a motor in it so it could fly; others have said they would make it stronger by building it from steel. How would you change it?

"Toy"

☐